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September 6, 1923

Engineering News-Record

Bascule Bridge of New Design

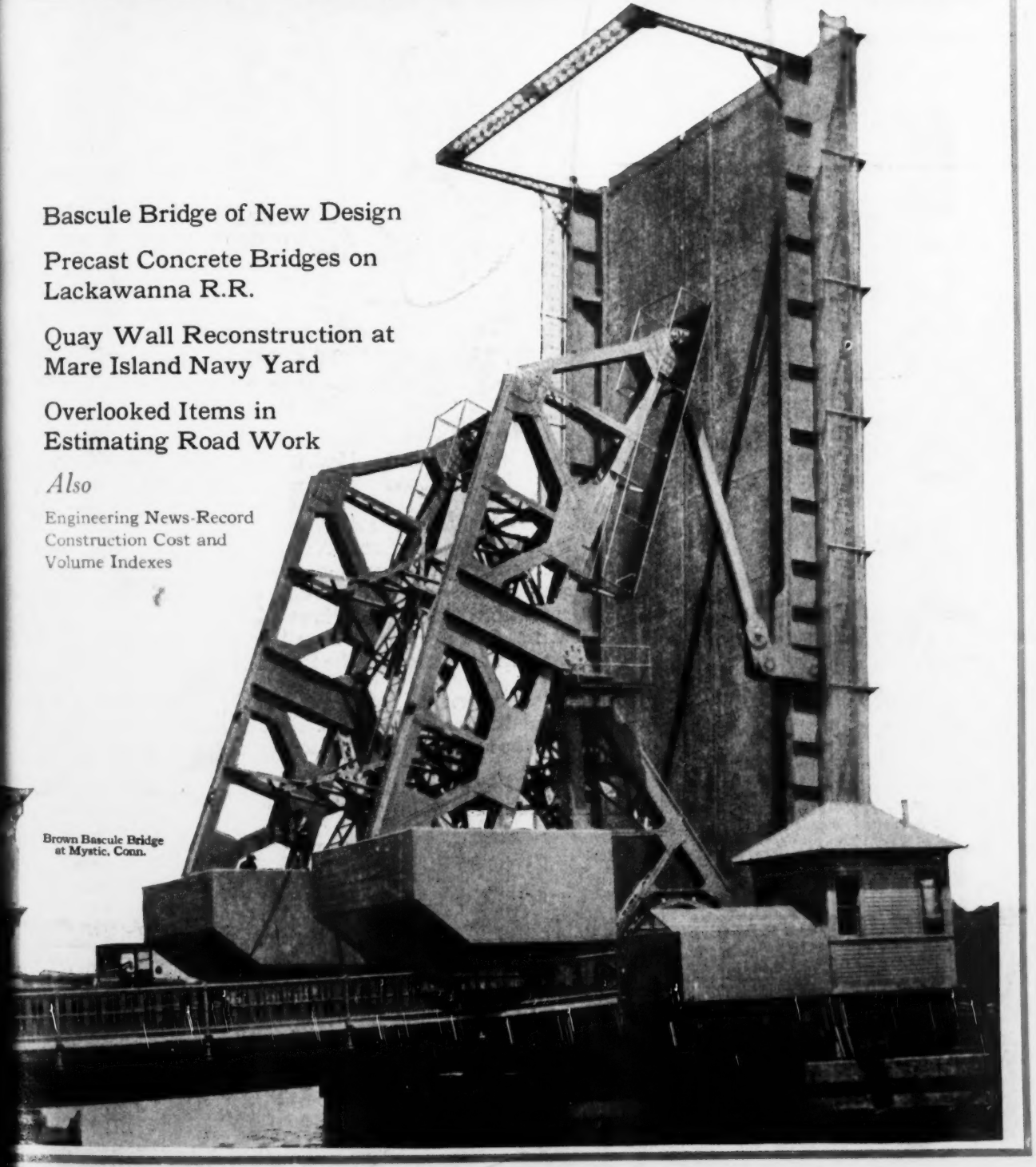
Precast Concrete Bridges on Lackawanna R.R.

Quay Wall Reconstruction at Mare Island Navy Yard

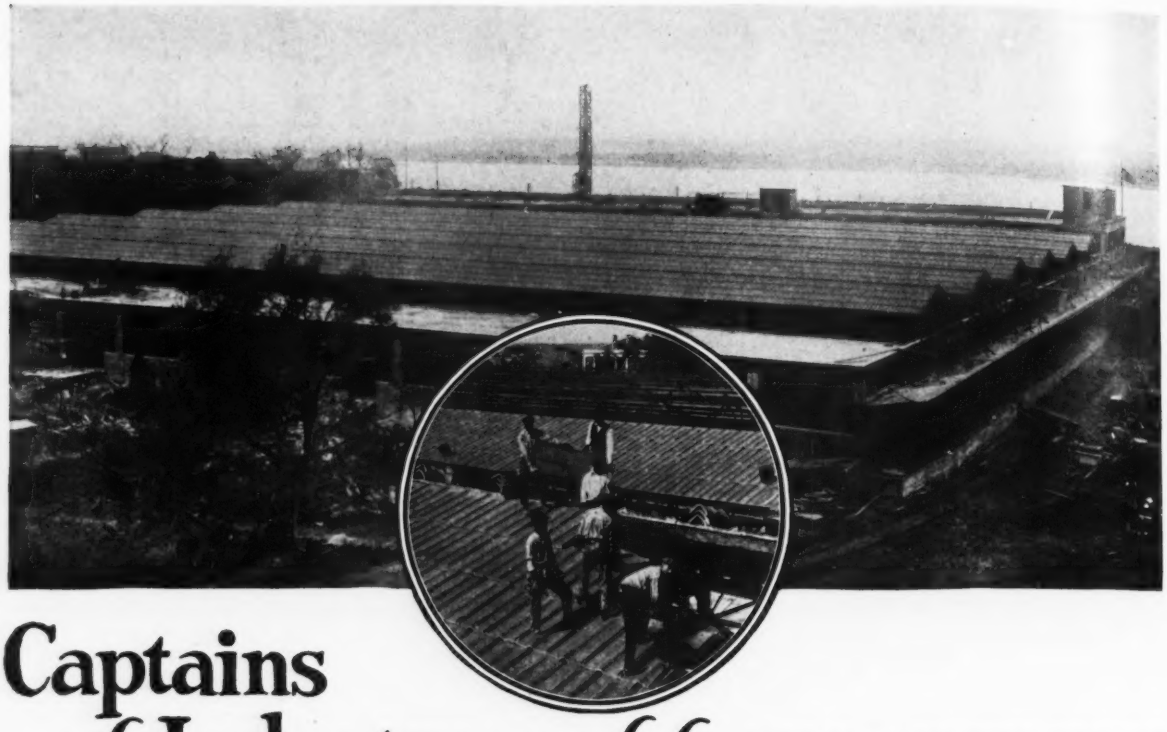
Overlooked Items in Estimating Road Work

Also

Engineering News-Record Construction Cost and Volume Indexes



Brown Bascule Bridge at Mystic, Conn.



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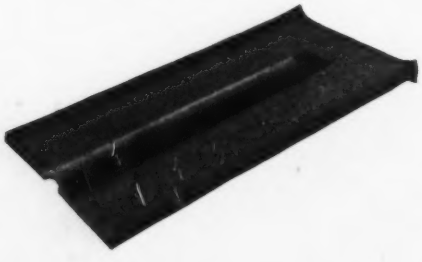

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

Volume 91 — NEW YORK, SEPTEMBER 6, 1923 — Number 10

Another Earthquake Disaster

AS WE go to press the first news comes of another mighty, historic earthquake in Japan. Such reports as have filtered out of the almost isolated country are sufficient to establish the appalling magnitude of the disaster, though their details are confused and hardly credible. The rumors of the destruction of numerous modern steel-frame buildings clash sharply with all that has been learned from prior earthquake experience, and for the present at least must be discounted. But earthquake visitation is fantastically erratic, and the years during which its effects have been studied are short indeed, so that it is by no means impossible that the details of a new disaster may give the lie to past conclusions. However its full facts may develop, the present catastrophe is great enough to dispel any belief that earthquakes are growing less frequent and less terrible. Modern civilization has to reckon with them fully as much as did earlier ages.

The Coal Commission's Duty

SEPTEMBER first has come and with it the anthracite coal strike. In spite of all the elaborate preparations made to prevent a repetition of last year's strike—the formation of a federal coal commission and the interposition of the Governor of Pennsylvania—the Juggernaut car of the coal industry proceeds on its appointed way. It is hardly to be believed that the "little group of wilful men" on both sides of the table will really defy the American people another year, but if they do they must take the consequences of drastic action in the coming congress. One thing is incumbent now on the coal commission. That body presumably knows more about the coal business than any other group of unprejudiced men. The people at large know nothing about the rights of the controversy, but they are entitled to a frank statement from that commission as to who is responsible for the present conflict. One might wade through the volumes of testimony and statistics prepared by the commission and come to some conclusion but it is not a fair thing to ask. The commission knows, or ought to know, whether the operators are making too much, whether the middleman is a profiteer and whether wages and working conditions are unfair to the workmen. The commission is obligated by the situation to state definitely where the guilt of this outrageous strike lies.

Recognition of Mexico

NEGOTIATIONS looking to a renewal of diplomatic relations between this country and Mexico have been under way for some time and last week word came from Washington announcing the full recognition of the present Mexican government beginning Sept. 1. This event will have an important influence on prospective engineering development in Mexico. Some projects that have not yet been financed may now be regarded in a more favorable light, American interests can expect better protection from their own government and, with American recognition, the Mexican government itself can be expected to look more favorably on development in Mexico backed by American capital. The recent start of construction to complete the gap in the railroad along the west coast will help conditions greatly; with direct rail connection through to Mexico City the danger of banditry in the heretofore isolated west will be lessened and there will be a means of transportation that will facilitate development. Perhaps the first and most attractive field for developments are in the oil and mineral resources of Mexico. These require but little exploitation. However, as soon as capital, particularly American capital, gains confidence, assurance of protection and an insight into the wealth, the extent and the variety of Mexican resources thus far practically untouched, there will certainly ensue an era of prosperity in which American engineers should have a generous share.

Light on Cement Prices

STATE authorities who are considering the construction of cement mills to reduce what they consider the high cost of cement will do well to study the figures on the profits of eleven of the large companies in the East submitted by Professor H. P. Willis, of Columbia University, and noted in the news pages of this issue. Doubtless Professor Willis will gladly furnish the full data on which he has based the figures that are given here, so that the state can check them for those items of investment and operation which should be of so much importance in any computation on the cost of state cement production. If private companies, with their wealth of expert aid and of experience, are unable to average more than 7.3 per cent earnings on their investment, there is certainly no reason why any state should consider prices so exorbitant as to enter into competition with them.

Shaded Topographical Maps

IF NEW methods of bringing out topographic relief on contour maps are successfully developed and brought into use, in pursuance of the present attempts of the Geological Survey, as outlined in this issue, the utility of what is sometimes spoken as the map of the United States will be increased in an almost sensational degree. Of the wealth of information contained in the contour map as now published, only a small part is readily available for use. For most kinds of topography the contour system beclouds and conceals rather than reveals the features of the country, and any general understanding of the lay of the land can be worked out only by previous detail study. This condition is a fatal bar to useful application of the map in a great number of cases where it would otherwise prove of value. Engineers, as well as other map users, have long felt the

desirability of some more plastic method of showing relief, preferably to be combined with contours in order not to sacrifice the numerical definiteness which these give. We believe that this feeling has grown decidedly in recent years, and that engineers in particular are anxious to have an improved system applied to the existing maps at the earliest possible moment. In selecting the best system and working out its details, however, the government authorities should be supported and guided by the opinion of map users. It is suggested that those who have definite opinions on the subject based on experience with topographic maps make their views available without delay, to assure the most rapid forwarding of the development of an improved system.

An Irregular Standard

LAST month we commented editorially on the extremes to which the enthusiasm for standardization can be carried. A minor, though illuminating, example has just come to notice. In this month's *Harper's*, in an excellent article on the railway problem, there is some preliminary comment on the establishment of the standard gage, in which the author by implication deplores the irregularity of the 4 ft. 8½ in. standard and is especially concerned over what he is pleased to call that "absurd one-half inch." This is characteristic of the craze for standards. It is assumed that there is some magically saving grace in even figures, that millions of dollars a year and thousands of useless brain throbs would be saved by an even 4-ft. or 5-ft. gage—all of which is just as absurd as that one-half inch is claimed to be. Fifty six and one-half inches is just as easy to remember and just as easy to measure as five feet, as every engineer knows and while one may be curious to know how the standard gage was arrived at certainly no railway man would go to any great trouble to change it to an even figure.

Not All Profits

TRAFFIC through the Panama Canal is increasing in surprising volume. In the nine years of its operation, which were completed last month, the paid tolls, which are a fair measure of traffic, amounted to $76,000,000. Of this amount $17,000,000 or 22 per cent were in the latest fiscal year. In the latest month the tolls were somewhat over $2,000,000, as against the average monthly for the nine-year operation of about $700,000. Taking these figures as a text, Governor Morrow, of the Canal Zone, who recently arrived in this country on his annual trip to Washington, has been extensively quoted in the daily press as stating that the Canal is now paying better than 3 per cent on its investment. This is hardly a fair statement, whether Governor Morrow said it or not. The government now has invested in Panama, according to the latest figures, upwards of $450,000,000, of which $400,000,000 can be probably charged to the Canal itself, the other $50,000,000 being bookkeeping liabilities which probably have compensating money assets. This extends back over a period of nearly twenty years. On even so low a rate as 3 per cent the investment has piled up in an average of ten years about $120,000,000 interest charges which in any private business would have to be accounted for in figuring profits. It is highly gratifying to everyone who favored the construction of the canal that it is now bringing in, clear of expenses, an income of approximately $500,000 a month. Even were the financial return not so great the value of the Canal would be unquestioned. It cannot be fairly said, however, that it is bringing in a profit on the investment except on the basis that all such government expenditures have their own type of accounting which does not come in the same realm of mathematics as that of private business.

Highway Accidents at Railway Crossings

EXAGGERATED importance is likely to be attributed to the railway crossing as a cause of highway accidents unless one holds his perspective true. Horror is aroused by their deadliness and by the complete demolition which usually results. A contributing reason perhaps is the fact that so few automobile accidents are due to other faults of road structure. Crossing accident figures are undoubtedly impressive. The Interstate Commerce Commission for the last quarter of 1922 reports 517 deaths and 1,710 other casualties due to this cause. This is a condition that obviously calls for change. Quite as obviously the only certain and complete remedy is grade crossing elimination. Eventually we must come to this perfect cure. Always its adoption should be urged. Always also, it has to be remembered, it is an enormous physical and financial task which cannot soon be accomplished and it is a primary duty meanwhile to undertake palliative measures. Our railway crossings are yet far from being properly protected by signals and barriers. Careless driving which is the major cause of all highway accidents has scarcely begun to be curbed. Statistics are not plentiful but all that can be found agree very closely. In Iowa in 1922 there were 6,513 highway accidents which involved casualties, and of these only 4¼ per cent were at grade crossings of railways. Referring to the total figure the state highway commission bulletin concludes that "reckless and careless driving would seem to be the cause of 90 per cent." In Wisconsin in eight months of 1922 there were 1,069 accidents of which 6½ per cent were at railway crossings. Again something over 70 per cent of all were due to careless driving. In every way the task of curbing reckless and careless driving is more imminent than that of producing accident-proof road structure including even the deadly railway crossing.

New York Garbage and Jersey Beaches

COMPLAINTS of New Jersey sea coast towns that their beaches are strewn with the garbage and refuse of New York City bring to mind the fact that it is now some five or six years since our largest American city returned to the primitive means of dumping its garbage and refuse at sea. In doing this it abandoned an engineering plan the main features of which were worked out by the late Col. George E. Waring, after extended studies by a staff of specialists—a plan also which in the main has been recommended for New York by other engineers after careful investigation. Not only that: the contractor whose garbage reduction plant in New York Harbor Mayor Hylan caused to be shut down was under agreement to pay the city for every ton of garbage the city delivered to the plant, while since the change the city has been paying for barging the garbage many miles farther to be dumped at sea, whence, according to the Jersey shore cities, it floats inshore to become a nuisance and to lessen the summer crowds on which the residents of these towns live.

Upon the controversy as to whether the beach litter comes from the city scows or seagoing vessels, we cannot undertake to pronounce. The fact of general engineering interest is that the largest city in the two Americas has for a half dozen years allowed its refuse disposal problem, and the refuse itself Jerseyites claim, to drift, while at the same time paying out large sums annually for dumping garbage containing grease and fertilizer base for the recovery of which a contractor was under agreement to pay the city. We are well aware that the contractor was in financial straits; that the plant was ordered closed because of allegations of nuisance; that the contractor did not contest the order—perhaps because the plant was losing money; and that the war garbage reduction, like pig feeding and incineration, has had its ups and downs—mostly downs. Notwithstanding all this, the city's action appears to have been grounded on pre-election controversies and promises and on political reprisals rather than on engineering considerations.

The present situation is accompanied with the usual wild statements about the relation of garbage disposal to the public health. Thus, Governor Silzer of New Jersey, according to a reporter's story in the Newark *News*, has "traced the appearance of a form of intestinal grip to germs in the garbage dumped from New York City." Can it be that Jerseyites are eating garbage these summer days? Worse than this—because it is an editorial utterance, and editors are supposed to show knowledge and judgment—the New York *Times*, after discussing sympathetically the Jersey coast allegations against New York garbage, turns to what it regards as New York's laxness in sewage disposal and closes with saying that the city is "apparently willing to continue its old makeshift system until some calamity, such as an epidemic directly traceable to pollution [of salt water, be it noted] shakes the authorities out of their apathy."

It is just this sort of tilting at men of straw indulged in to arouse public opinion to the need for better garbage or sewage disposal that is largely responsible for such apathy as exists. The cry of "wolf, wolf" soon fails to alarm. Some ill-informed and unthinking people may be roused to momentary excitement over "epidemics," threatened by a dead cat in the street, garbage on a bank of snow in the dead of winter, watermelon rinds on a beach, "sewage slick" in a harbor, or offensive sights and odors in dock slips or alongshore; but the underlying commonsense of the people at large and the experience of communities as well discounts such alarmist outcries. The taxpaying public and city authorities responsible for it will spend money to insure the purity of their water supply and, as enlightenment progresses, of the milk they drink, because they have experienced to their sorrow that impure water causes typhoid and contaminated milk results in typhoid, infant mortality, tuberculosis, and other ills; but subconsciously, at least, they know that garbage and sewage, once these wastes are well clear of their homes, will, as a rule, produce nothing worse than bad sights and smells—barring the pollution of public water supplies, which is now generally well guarded against by one means or another. When the smells are bad enough, or a community becomes unusually sensitive or supersensitive to them it will, on that account but not because of real and well grounded health fears, appropriate money for improved means of sewage and garbage disposal.

New York today, to return from the general to the particular, is spending large sums for a primitive means of garbage and refuse disposal; but it is only fair to add that under existing conditions affecting both the incineration and reduction of garbage it is conceivable, until competent engineering studies demonstrate the facts one way or the other, that New York's refuse might be towed so far out to sea as to insure its never or rarely returning to shore, at less than the net cost of reduction or the cost of incineration, though for the latter there is little promise of revenue in the light of all American experience and of British experience of recent years. It is also only fair to the New York authorities to say that progress is being made on a systematic plan for sewage disposal.

Garbage and refuse disposal problems are more than ever for engineers to solve and for politicians to let alone, except as the latter choose from possible engineering methods the one most likely to meet the demands of an intelligent public opinion rather than of political expedience or revenge.

More to Come on Earth Dams

THE Apishapa Dam, the failure of which was noted in *Engineering News-Record* last week, bids fair to become a celebrated case in dam engineering. Earth dams of such height and volume are always an interesting problem, because their design and construction continue to be more empirical than in other types of dams, and failure is important in the development of the art of their design because by failure alone can there be absolute assurance that something went wrong. To discover just what that something is is the difficult sequel of all such dam failures.

In the Apishapa case this is the outstanding fact at present. There are so many inconsistencies and contradictions in the various reports that have come in to *Engineering News-Record* that it has been decided to postpone publication of any of them until next week, or a future time when a fair degree of consistency in the reports can be assured. Two important details, however, may be noted for future reference. The first is the diametric opposition as to the desirability of early filling of the reservoir behind dry fill earth dams and the second is the historical significance of the protests of the designing and constructing engineer during the construction of the dam.

One observer writing in claims that to leave dry such a dam in the arid west is to invite failure by sudden filling of the reservoir. The designer, on the contrary, stipulated in his preliminary reports that the reservoir should not be filled for some years, during which time the dam was to be allowed to settle and densify. Here is obvious contradiction that needs explanation and it is on a point which is most pertinent to the design of the dry emergency dam such as built at Dayton and planned at Pueblo.

The designer's ungranted plea for additional height and section, with his subsequent disclaimer of responsibility in case of failure, has a dramatic element not usually associated with the prosaic business of dam building. Whether or not the failure was due to matters he wanted corrected remains to be seen, but he is at least entitled to his day in court. His interpretation and the full reports on the failure should be important contributions to the art of earth dam building.

A Bascule Bridge of New Type and Its Construction

Varying Effective Length of Hanger Link Maintains Balance—Bull-Wheel and Worm-Gear Operation—Toe Locks Eliminated—Creosoted Lumber Framed and Bored at Mill

BY THOMAS E. BROWN, JR.
Consulting Engineer, New York
AND
WILLIAM G. GROVE
American Bridge Co., New York

SEVERAL unusual features distinguish a new bascule highway bridge at Mystic, Conn., completed last year. It is the first bridge of a newly developed type, in which the counterweight rotates through a considerably smaller angle than the span. At Mystic the counterweight rotates through an arc of only 69 deg. while the span is traversing a full right angle. This is accomplished by means of a double-pivoted short link forming part of the hanger link, and a stop on the moving-leaf girders which changes the effective length of the hanger link during the motion. The small angle of rotation of the counterweights permits of their being placed symmetrically about the center lines of the balance beams without interference with the tower, and keeps girder, tower, balance beam and counterweight all in the same plane, obviating the necessity of carrying loads transversely.

A bull-wheel method of operation is used, which incidentally locks the span in its closed position. Worm gears are successfully employed, eliminating the noise of high-speed spur gearing. Special details were introduced to permit the concrete sidewalks and wood-block roadway paving to be raised with safety to the vertical position. The counterweights were poured in their high position with a small under-support. Framing and boring of the creosoted lumber at the mill was used with success.

General Description—The completed bridge consists of four through plate-girder spans; the main or movable span of 84 ft. 8 in., a tower span of 23 ft., and two simple approach spans. (Fig. 1 shows profile and plan of bridge.) The bridge is on the New York and Boston Post Road and carries traffic of large volume and heavy weight, including motor trucks and a single-track interurban trolley line, together with considerable pedestrian traffic. To meet the traffic needs, a roadway width of 33 ft. in the clear was provided, with a single trolley track in the center. The roadway is paved with creosoted wood block. The sidewalks are 5 ft. wide and are paved with a 3-in. reinforced-concrete slab. (Fig. 2 shows a cross-section of the movable span.)

Selection of Type—In the selection of the particular type of bridge for the opening, various types of movable spans were considered. The required channel width was 75 ft., with a clear vertical height of 135 ft.; this relatively great height of channel clearance compared to the length of span excluded the vertical lift. The extreme width of the bridge, practically 50 ft. over all, would require a swing span at least 210 ft. center to center of end wedges if the bridge were made symmetrical with both arms of equal length. However, as buildings at both ends of the bridge extended up to and in some corners in front of the abutments, and a symmetrical swing span would have extended about 25 ft. over the west abutment, a bobtail swing would have been required, which in turn was prohibited by the location of the center pier and the channel.

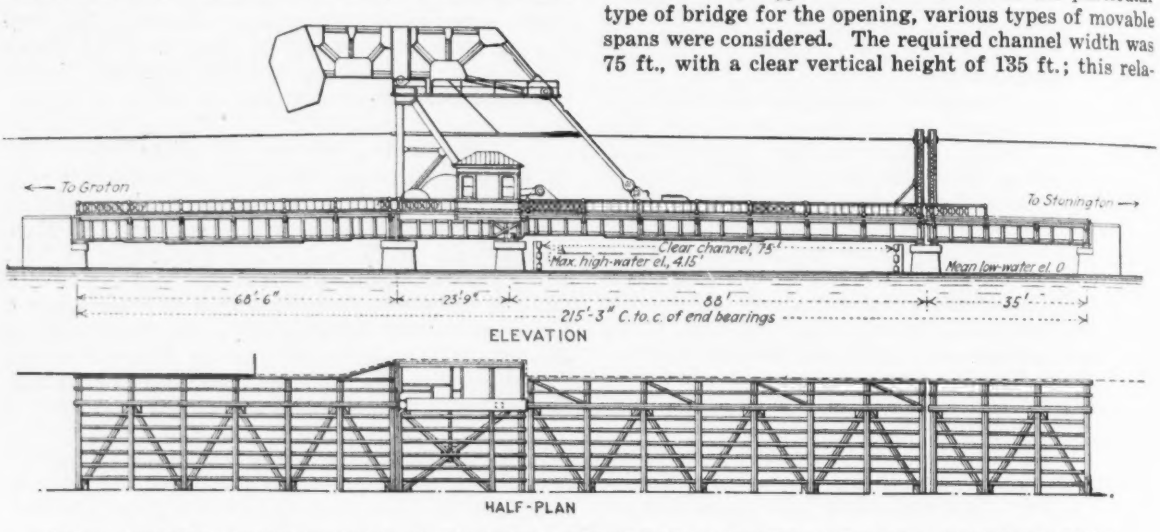


FIG. 1—GENERAL PROFILE AND PLAN OF NEW BROWN BASCULE HIGHWAY BRIDGE AT MYSTIC, CONN.

The elimination of the swing and vertical-lift types necessitated the use of some kind of a bascule, and after careful consideration and comparative estimates it was decided to adopt the Brown "balance-beam" type. There are several advantages of this type over the older forms of bascule, and as the bridge at Mystic is the first of its kind to be built a short description of the method of balance is of interest.

The movable span is counterbalanced by two concrete weights placed on the center lines of the main girders and carried by balance beams in the form of trusses which rest on trunnions at the tops of the tower bents. These trusses are about 60 ft. long over all, and their forward ends are connected with the plate girders of

the moving span by hanger links or suspenders consisting of eyebars and short links having double sets of pivots at the span end. (See Fig. 3.) Butt blocks or stops are suitably placed on the upper flanges of the movable-span girders to make contact with the short links at the proper time during motion, and thus change the point of rotation of the eyebar hangers from one set of pivots to the other. This system of multiple pivots is the important distinguishing feature of the new Brown type.

Fig. 4 is a diagram showing the action of the pivots and butt blocks as the span rotates through its 90 deg. of motion. Between positions I and II of the span (see Fig. 4), or for about the first 38 deg. of motion, the hangers rotate about the primary pivots *A*. The butt blocks then make contact with butt castings on the short links, preventing their further rotation about pivot *A*, as shown in position II. From this position throughout the remainder of the opening, the eyebars rotate about the pivots *B*, on the ends of the short links.

It will be noted in Fig. 4 that in the closed position of the span, when its center of gravity is horizontally in front of its trunnion, the center of gravity of the counterweight is well above the level of the balance-beam trunnion, and that in the open or 90-deg. position, when the span is vertical, the counterweights are considerably back of the vertical tower legs and entirely clear them; that is, the span has rotated 90 deg. while the total angular motion of the counterweight is only 69 deg. Throughout the entire motion no attempt is made to keep the lever arms or the angular motions of the span and of the counterweights about their respective trunnions equal or similar in any way, the balance being maintained entirely by selection of the pivotal points *A* and *B* so as to reduce and increase the respective lever arms of the hanger links about the balance beam and the span trunnions in proportion as the moments of the counterweights and the span vary about their respective trunnions.

There are several advantages with these two pivotal points of rotation. The counterweights, not having to pass between the tower legs, can be built centrally over and integral with the balance-beam trusses; thus all the stressed members from girders to counterweights are maintained in the same plane, saving a considerable amount of steel usually required for lateral transfer of forces or of counterweight loads. The counterweights being in two sections entirely disconnected, no rigid bracing is required between the balance beams. Light bracing only is required, which though rigidly providing against lateral overturning of the beams yet allows a slight flexibility of motion in the planes of the trusses and thus provides against the possibility of binding of trunnions or pins and against inequality of stress in the hangers due to the usual slight inaccuracies in lengths of members and in lining up of trunnions in the field.

Again, there is great latitude in the choice of the positions of the points *A* and *B* while retaining the practical balance throughout the motion. In the Mystic

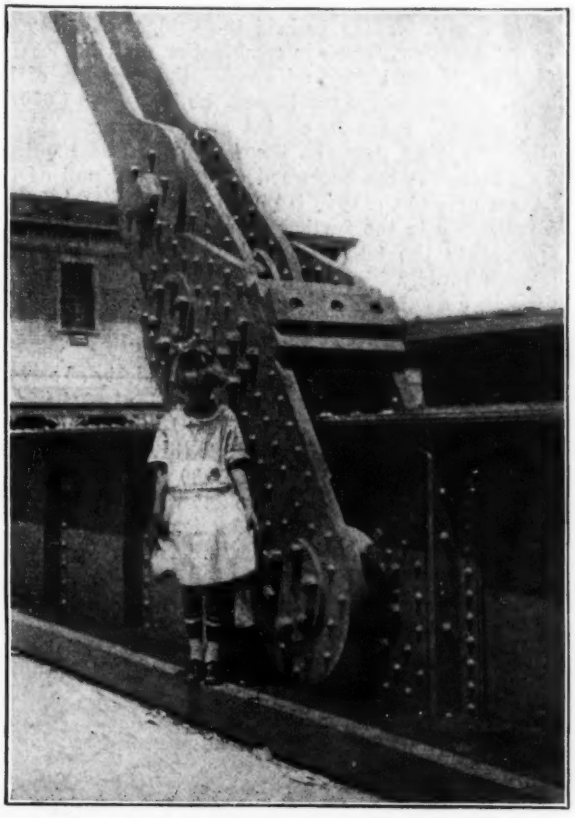


FIG. 3—SHORT LINK AT BASE OF MAIN EYEBAR HANGER

This link in conjunction with the butt-block on the girder, in the foreground, changes the leverage of the counterweight as the span rises.

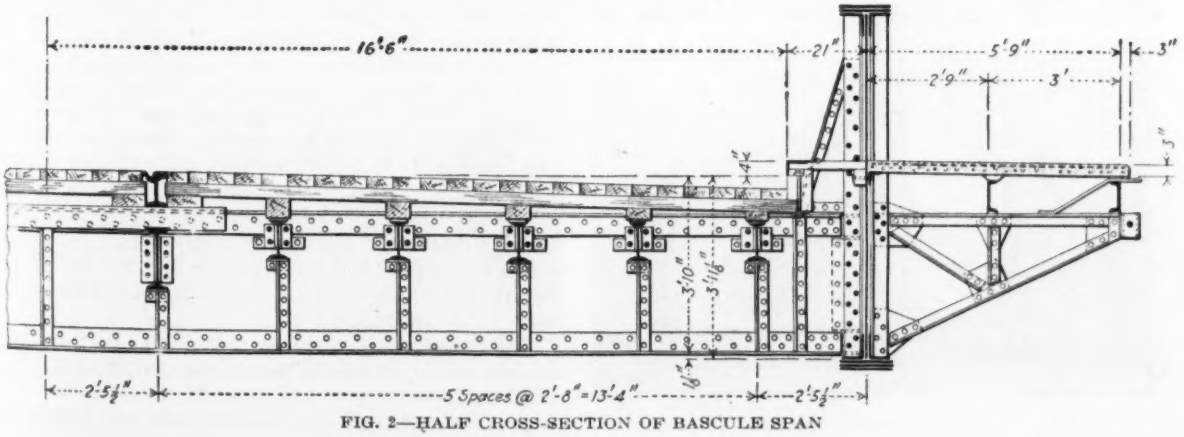


FIG. 2—HALF CROSS-SECTION OF BASCULE SPAN

design point *A* was so chosen as to provide an unbalance when closed, tending to hold the bridge well down on its toe bearings, which in combination with the locking function of the bull-wheel avoided the necessity of toe locks. This positive reaction at the toe end is 1,000 lb. per girder. Point *B*, on the other hand, was placed slightly higher than the theoretical position required. This increases the backward or downward pull of the hanger around the span trunnion (see Fig. 4), offering a resistance to the further opening of the bridge as it approaches the 90-deg. position. The resistance increases rapidly if the span passes the vertical, thus providing a safety factor against the span being blown or operated backward against the tower.

A further advantage is the adjustability of point *B* by shimming in the butt block to obtain nicety of balance or to compensate for a change in dead load of the floor.

Power Equipment and Machinery—On the Mystic bridge the main source of power is three-phase 60-cycle alternating current delivered at 2,200 volts to the bridge site, where it is transformed to 220 volts. Operation is by two 36-hp. motors of the induction type, one on each side of the tower span, placed on unit frames with worm-gear units of a ratio of 20 to 1. By the use of worm-gear units the operating machinery was made so compact

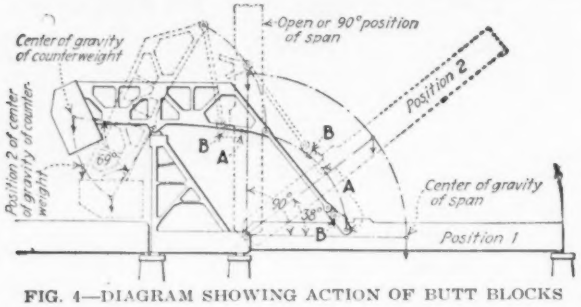


FIG. 4—DIAGRAM SHOWING ACTION OF BUTT BLOCKS

as to enable it to be placed below the sidewalks on the tower span, because from this worm reduction only two spur gears were required to reduce to the pinion which meshes with the teeth on the periphery of the bull-wheel. An additional advantage in the use of worm gears is that they avoid the necessity for high-speed spur gearing, and hence the operation of the bridge is remarkably smooth and noiseless.

The bull-wheels and their pinions are in the planes of the tower bents, and the forward ends of the bull-wheels are connected by links or "connecting rods," which straddle the front legs of the tower, to operating pivots on the main bascule girders. The lengths and

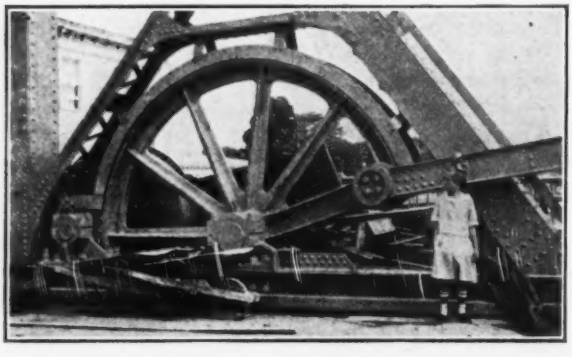


FIG. 5—BULL-WHEEL

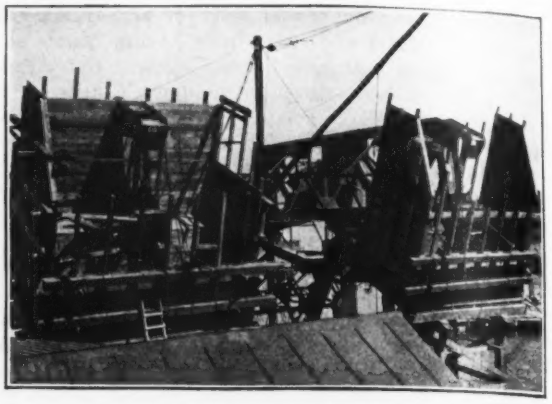


FIG. 6—FORMS FOR COUNTERWEIGHTS

positions of these links are so adjusted that when the bridge is in its closed position they are practically on dead center with the axles of the bull-wheels, thus locking the bridge in this position (see Fig. 5). This bull-wheel lock in combination with the unbalance of the span, already described, enables toe locks to be dispensed with. The bull-wheels also provide greatly increased leverage at the two extreme positions of the span. As the operating links approach the dead-center position at the extreme ends of the run, the combined leverage of the machinery approaches infinity and the speed of the span approaches zero. This permits very gentle seating of the span with motors running at constant speed. In fact if, through inadvertence on the part of the operator, the motors should continue to run after the span is seated, the links will pass the dead-center position and open the bridge, instead of stalling or short-circuiting the motors. Likewise in open position, when the span offers the greatest wind-sail area, the operating links have reached the other point of increased leverage, which condition combined with the automatically increased unbalance of the span makes it an impossibility for the span to be overturned against the tower, regardless of the wind velocity.

The two independent machinery reductions on each side of the bridge are connected by the usual transverse shaft. The motor shafts are equipped with solenoid brakes, and in addition emergency air-brakes are provided on each end of the tranverse shaft. Either set of brakes may be used independently. The usual emergency hand operation is also provided.

Erection—On account of the extreme simplicity of the structure no particular problems were encountered in the erection with the exception of the placing of the concrete counterweights. The original design had been made with the idea of erecting the bridge in open position, for which purpose the approach span at the rear of the tower had been designed with a view to supporting the forms and the counterweights while the latter were being poured in their lowest position, with the center of the counterweight 9 ft. from the center of the pier. But it was found much simpler to lay the concrete sidewalks and wood block paving with the span horizontal so that the decision was later reached to erect the entire span in the closed position.

The counterweights therefore had to be built in their upper position, in which they were a horizontal distance of 24 ft. from the pier and about 32 ft. above the roadway. The approach-span girders were not sufficiently

strong to support the entire weight in this position with the additional framework required. The solution of the difficulty was to carry the greater part of the load from the balance beams.

This was accomplished by putting up light staging on the approach span, sufficient to carry the weight of the forms and also the weight of a 2-ft. bottom slab of concrete; then, before pouring this bottom slab, wire guys or tie ropes were attached to the top of the balance beams and brought out through the bottom of the forms. After the bottom slab had set, the remainder of the concrete was poured. Fig. 6 shows the counterweight forms.

The requirement that the span must open to 90 deg. necessitated considerable care in the laying of the wood-block paving and the concrete sidewalks. Each individual block on the lift span was separately nailed to the sub-planking with a wire nail through the center of the block. In addition, horizontal angles about 10 ft. apart were laid on both roadway and sidewalks, to act as shelf angles supporting independent 10-ft. sections of the wood-block paving and concrete when the span is in the open position.

A special feature in connection with the field work was the boring and framing of nearly all of the creosoted lumber at the mill, although cutting and boring before cresoting was not required by the specifications. Steel erectors are averse to handling creosoted lumber, and it was therefore decided to relieve them of a large portion of this work. The spiking pieces, curb guards, ties and other miscellaneous lumber were framed and bored before creosoting, so that very little field work was necessary, the principal part being the boring where steelwork or other bored lumber was used as a templet. The lumber was given marks at the mill similar to shipping marks on steelwork. The erection department was well pleased with this method of handling the lumber, as it saved considerable expense and time besides relieving the erectors of an uncongenial task.

Conclusion—The total weight of steel in the bridge is about 400 tons; the weight of the moving leaf complete is about 200 tons. The concrete counterweights weigh 400 tons, while the total weight of the moving parts is about 650 tons.

The bascule and tower spans were designed by Thomas E. Brown & Son, consulting engineers, for Waddell & Son, who were consulting engineers to the state highway department for this portion of the work. The approach spans and the substructure were designed by the state highway department, L. G. Sumner, chief draftsman. The substructure work was done by the J. E. Fitzgerald Co; the structural steel superstructure and machinery were fabricated and erected by the American Bridge Co.; and the concrete counterweights were placed by the C. A. Sibley Co. The bridge was built for the state of Connecticut under direction of Chas. J. Bennett, formerly highway commissioner, R. L. Saunders, formerly deputy commissioner, A. W. Bushell, district engineer, and A. R. Collier (now state supervisor of bridges), resident engineer.

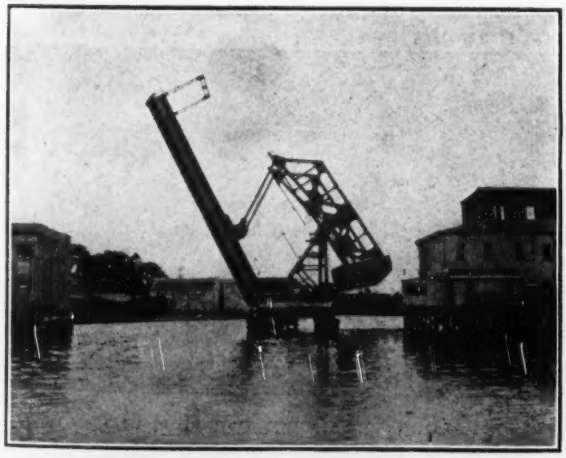


FIG. 7—MYSTIC BASCULE PARTLY OPEN

Camp Site Sanitation in Wisconsin

DUE to the thousands of tourists who camp out in free sites maintained by cities as one of the summer attractions for patronage, attention has been given in Wisconsin to safeguard public health and insure comfort for the patrons. In a recent bulletin issued by the State Board of Health the following essentials in campsite sanitation are noted:

(1) Provide a safe water supply such as wells or springs protected from pollution. Have the water analyzed before the season opens.

(2) Adequate sanitary toilet facilities should be maintained.

(3) Provide garbage and refuse receivers and a daily disposal. If there are no containers, bury or burn the waste.

(4) Maintain clean premises and equipment.

(5) Enforce rules conspicuously posted governing use of grounds.

(6) Eliminate fleas and vermin by every means available.

(7) Employ a caretaker and give him authority to enforce sanitary regulations.

It is encouraging, say the health officials, to note that the municipalities boosting campsites are shaping their plans toward the observance of these rules and in not a few places have these ends been achieved.

Syracuse Garbage Reduction Works Reopened

The Syracuse garbage reduction works, which were shut down for some months, were reopened in the latter part of June, after having been remodeled. The works are being operated under a five-year lease made after the city had advertised for bids. The contract, which included also a certain amount of remodeling, was awarded to the C. O. Bartlett & Snow Co., Cleveland, Ohio, which organized the Cobwell Reduction Co., a New York corporation, to carry out the terms of the contract. The city pays the company $30,000 a year to cover both operation and amortization of the cost of remodeling the plant, the capacity of which was increased to 125 tons per day or more than double the original capacity of the plant as built by the city. In the plant as it now stands, the garbage is first shredded and then fed to the dehydrators, both operations being mechanical. The dehydrators are of indirect-direct heat type. They reduce the free moisture content to about 30 per cent. In the dehydrators the remaining moisture is eliminated, the material is broken down under low temperature and the grease extracted, all this work being done as a continuous process within the closed receptacle. After the process thus outlined is completed, the remaining solid material is screened and then conveyed to storage.

Iron Removal and Softening Plant, Benton Harbor, Mich.

Preliminary Experiments Indicated Use of Lime for Reduction of Iron Carbonates—Softening Added to Process

NOVEL features of the iron removal plant at Benton Harbor, Mich., comprise mixing chambers equipped with stirring devices and so arranged that a portion of the water delivered to the plant may be over-treated with lime before being mixed with the remaining portion. The stirring devices themselves in the mixing chambers are not entirely new as these were probably first used on a municipal plant by Philip Burgess at Owensboro, Ky. Over-treating a portion of the water was suggested by the experience at the Grand Rapids filter plant. The combination of the arrangement and equipment, however, is believed to be rather unusual. Another feature, first suggested by C. P. Hoover, is the use of a Dorr thickener in the sedimentation basins. This clarifier has two functions: (1) It removes the

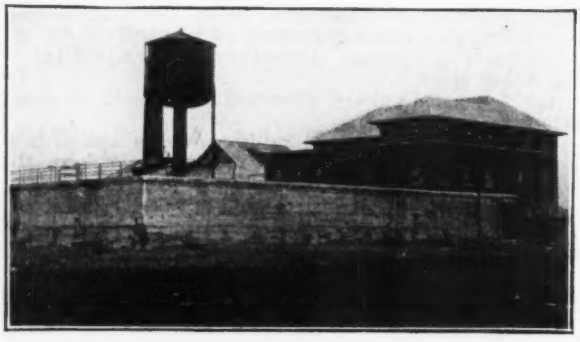


FIG. 1—IRON REMOVAL AND SOFTENER PLANT

bulk of the sludge continuously so as to reduce the number of times that the sedimentation basins must be emptied and cleaned. The peculiarities of the locality are such that this operation involves pumping out the lower portions of the sedimentation basins, an operation which is costly, time consuming and troublesome. (2) Means are provided for returning a portion of the settled sludge to the raw water so as to promote rapid reaction and precipitation of the lime with the bicarbonates in the water.

The plant has a nominal capacity of 2 m.g.d. Under this rating the mixing chambers have a retention period of 50 minutes, the Dorr clarifier 1 hr., and the sedimentation basins 8 hr. A clear water storage of 700,000 gal. is provided.

Hitherto the city obtained its public water supply from wells in the sand and gravel beds bordering the St. Joseph River. The yield of these wells was not sufficient to meet maximum summer demands. Moreover, the water contains some 2 p.p.m. of iron which caused very objectionable staining of plumbing fixtures and also favored the growth of crenothrix in the mains. The water carries about 250 p.p.m. of hardness, all in the form of carbonates of calcium and magnesium. The magnesium content is high, about 23 parts per million.

The city authorities decided to utilize the St. Joseph River as a source of water supply, as being the most certain in point of quantity and the most economical. It was proposed to render the water of good sanitary quality by purification. Lake Michigan water would have been preferable because it is generally materially softer than the river water, but the distance to Lake Michigan rendered this project unduly expensive.

The principal objection to the river water is its warmth in the summer time and there is also a sentimental objection to its sanitary quality even if it is not delivered into the mains until passed through a filter plant. To obtain the advantages of both the well water and the river water it was decided to build a plant which could be utilized to remove the iron from the ground water or purify the river water. Preliminary experiments that were conducted with a view to determining the best design and proportions for a plant for removing the iron from the ground water revealed the necessity of using lime to precipitate the iron. This suggested the desirability of softening the water, as the hardness is in the form of carbonates in both river and well water. Accordingly, the functions of the plant were enlarged to include partial softening—partly for economy and partly because it was believed that if the water is reduced in hardness to a Lake Michigan water standard, it would prove satisfactory to all concerned.

The experimental plant comprised the usual component parts of a rapid sand filter plant; coagulant preparation and feed devices, mixing chamber, sedimentation basins and rapid sand filters. In addition, a 10-ft. gravel filter or adsorption tower, a lime saturator and an aerator were included. One set of experiments without chemicals of any sort indicated that aeration and 4½ hr. of sedimentation had no material effect on the removal of the iron. However, the iron was taken out almost completely in the sand filter. This method of treatment was regarded as objectionable since accumulations of iron and crenothrix growth in the filter may be anticipated which would tend to unfit the filter for the treatment of the river water.

Another series of experiments with alum as a coagulant was unsatisfactory. The sedimentation basins failed to take out any material amount of iron and it was found practically impossible to obtain a good alum floc. The mechanical filter, as in preceding experiments, removed the major portion of the iron.

Experiments with the use of lime developed what the engineers regard as a satisfactory method for removing the iron. After the application of lime the sedimentation basins were able to reduce the iron from 1 to 0.2 or 0.3 p.p.m., which was carried to somewhat less than 0.1 p.p.m. by the mechanical filter.

FIG. 2—DORR THICKENER FOR SLUDGE REMOVAL
Continuous instead of intermittent removal of sludge is obtained in the water purification plant by adapting sewage apparatus to the water purification process.

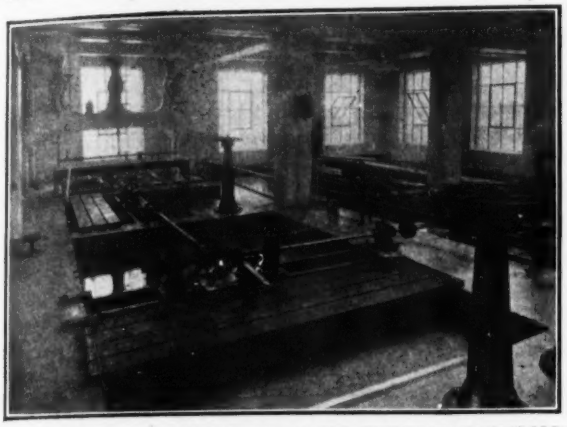


FIG. 3—MIXING CHAMBERS OF 1-HR. DETENTION PERIOD
Four units with motor-driven stirrers. In background at left are three chemical dry-feeders.

Further experiments were conducted to determine the efficacy of back treatment with alum to prevent incrustation of sand grains. It was observed in the experiments that whenever there were normal carbonates in the effluent from the sedimentation basins a reduction in alkalinity took place during the passage of the water through the filter.

The adsorption tower was found to reduce the iron to 0.3 or 0.4 p.p.m., with rates up to 250 m.g.d. per acre. The tower experiments were not pursued to a finality, as it was found feasible to remove the iron with ordinary devices included in a rapid sand filter. They may, however, prove of value elsewhere especially if some satisfactory means can be devised for cleansing.

Both experimental work and subsequent design and construction of the combined filter and softener were carried out under the direction of Pearse, Greeley & Hansen, consulting engineers, Chicago.

Observations on the Failure of Structural Materials

Japanese Tests Point to Influence of Internal Friction and Indicate a Constant Angle of Friction

BY GEORGE PAASWELL
Consulting Engineer, New York City

THE PHENOMENA attendant upon failure of structural units are usually dismissed by the engineer with the thought that, being without the province of elastic law, they can have no bearing upon elastic stress distribution. As a matter of fact, it is now becoming recognized that tests to destruction serve to show more than mere maximum loads. A recent paper by Chidô Sunatani (in "Technology Reports of the Tohoku Imperial University, Sendai, Japan," Vol. III, No. 1, 1922) serves to illustrate the fact that the study of the failure of stressed bodies may modify accepted notions of elastic behavior and limit permissible stresses to certain ratios of the fundamental shear and tension stresses.

Engineers are beginning to recognize that, however complicated the applied stress distributions, impending failure is controlled by the elementary shear or tension stresses on planes determined by the maximum-stress theory of ordinary elastic law. Failure tests aid in indicating how such surfaces of maximum stress may be located. Thus cylinder tests for compression on concrete illustrate shear failure, not compression failure, and the permissible compression stress is really the permissible shear stress from the applied load.

When does a body fail? There are three theoretical criteria upon which failure is assumed to depend. Failure is believed to occur either (1) when the applied load reaches a certain value, the criterion of maximum stress; (2) when the elongation in the direction of the load reaches a certain amount, the criterion of maximum strain; or (3) when the maximum shear due to the load reaches a certain value, the criterion of maximum shear. According to the first two, failure surfaces should be normal to the applied load; according to the third, failure surfaces should make an angle of about 45 deg. with the load axis, depending somewhat on the nature of the material (brittle or ductile).

As a matter of fact, tests verify none of these deductions. Mr. Sunatani has conducted a series of torsion, tensile and compressive tests, and has found failure surfaces that seem to depend upon an angle of internal friction ϕ. Previous investigators (Mohr, Hartmann, etc.) have recognized the possibility of internal friction in elastic structures, and the appearance of Lüder lines in a tension specimen of ductile material is explained on a frictional theory. It is questionable whether such internal friction assumes an important rôle within the yield point; but at or near failure, Sunatani demonstrates quite clearly, internal friction does play an important rôle.

Two types of failure are distinguished: a sliding failure, such as occurs in brittle material under compression, and a tensile failure, such as a brittle material would suffer under simple tension. The failure of a ductile material under tension exhibits some of each type of failure, the outer shell of the specimen yielding to a sliding failure, the inner core to a tension failure.

For the case of sliding failure, the determination of the maximum stress is made upon the basis of a shearing resistance in the failure plane (the usual tangential component of stress) and the frictional resistance (which is the product of the internal friction coefficient k, or tan ϕ and the normal stress on this plane). Determining the plane upon which this composite stress becomes a maximum, the author finds that for simple tension, sliding occurs along a plane making an angle of $45° - \frac{1}{2}\phi$ with the axis of the tension load, and the shearing stress, R, bears the following relation to the applied unit stress, t:

$$R = \frac{1 + \sin\phi}{2\cos\phi} t$$

If the applied loading is compressive, the numerator of the equation takes the form $1 - \sin\phi$. For a torsion load, where f_s, the torsional shear, is obtained from

$$f_s = \frac{3M + a\frac{dM}{da}}{2\pi r^3}$$

(M is twisting moment, a is angle of twist, and r the radius of the member), the limiting shear of sliding failure is

$$R = f_s/\cos\phi$$

Here f_s and t are stresses that may be computed from usual tests, the former by means of the equation just given, the latter by taking the quotient of the applied load and the area of the section. Since the controlling shearing stress R is the same for either case, the angle ϕ may be obtained from

$$\sin\phi = 2\frac{f_s}{t} - 1$$

With the ratio of the unit stresses as obtained by tests upon the same material for torsion and for compression, the author finds that the shear stress is about 0.7 of the tension stress, which gives a value for ϕ of approximately 20 deg. Measurements of the angle of the fracture planes of wrought iron, mild steel, brass and copper, indicated with experimental exactness that this is a correct value of the angle.

In similar fashion the author derived an expression for maximum tension on a plane, the resistance of the plane being controlled by the normal tension stress as indicated by usual elastic theory, and a tangential frictional component, the product of the internal friction coefficient k and the shear stress. This formula indicates failure surfaces making angles of $\frac{1}{2}\phi$ with the horizontal. Tests upon brittle specimens, such as plaster, chalk and cast-iron, again gave a value of the internal friction angle of 20 deg. That this angle appears constant leads the author to state that "the effect of the normal component of stress on the shearing resistance is equal to that of the tangential component of stress on a tensile resistance."

From these observations, the resistance of a material to failure is a function of the internal angle of friction, so that for a ductile material subjected to a tensile stress the shearing stress occurring on a plane of maximum stress must be less than 0.7 of the applied unit stress of tension. Ductility or brittleness may be defined by a characteristic type of failure, a ductile material starting to fail by shear, a brittle material starting to fail by tension, both under tensile loading. This distinction is a novel one, and the author follows it up by the statement that, as the ratio of the composite shearing strength to the composite tensile strength is greater or less than 0.7, the material is to be regarded as brittle or ductile.

As to the ratio between the composite compressive and tensile strength, the formulas give

$$f_c = \frac{1 + \sin\phi}{1 - \sin\phi} f_t$$

With the angle of internal friction 20 deg., the compressive strength should be approximately twice the tensile strength. Experiments made to verify this ratio were not conclusive, however. The author ascribes this to flexural stresses in the compressive specimen. Offhand the conclusion that the compressive resistance is twice the tensile resistance appears preposterous. It may be, however, in view of the fact that so little is really known of true compression failures, that the ratio is correct and that more careful experimentation may confirm it.

The above ratio is identical with the one Rankine obtained for granular materials. It is possible, therefore, that soils, possessing quasi-elastic properties, have angles of internal friction constant and independent of the soil constituents.

Summing up the author's work, it appears that the angle of internal friction is constant for all elastic solids, having a value in the neighborhood of 20 deg., and that in consequence the failure type and the corresponding weak planes of that type may be predicted with reasonable accuracy, once their classification as brittle or ductile materials is determined. As an indirect conclusion, the mechanics of failure appears to be amenable to elastic theory and there is hope that more detailed attention will be paid to the characteristics of fracture rather than mere ascertainment of the breaking load.

Reservoir Loses 84% of Storage Capacity in Nine Years

Measurements of Silt Behind Old and New Austin Dams in 1900 and 1922—Stream Flow Has Ranged From 160,000 to 9 Sec.-Ft.

By T. U. Taylor
Dean of Engineering, University of Texas, Austin, Texas

MEASUREMENTS made in each case by the writer show that the silting up of the reservoir formed by the new dam across the Colorado River at Austin, Texas, decreased the storage capacity by 83.84 per cent in the nine years ending in the summer of 1922, compared with a decrease of 62 per cent behind the first dam in the four years ending May, 1897, and 52 per cent for the 6¾ years from May, 1893, to January, 1900. The amount of water stored behind the old dam in the 2¾ years between the 1897 and 1900 measurements increased due to the flushing out of silt, notably by a flood which caused a 9.8-ft. depth of water over the crest of the old dam in June, 1899. It should be noted that the river cross-sections on which capacities for 1893 are based were taken in 1893. Details of the author's measurements are given below, together with notes on various Colorado River floods and on the minimum floods on record. [For the earlier measurements, reference may be made to an article by Prof. Taylor on "The Silting Up of Lake McDonald and the Leaks in the Austin Dam," *Engineering News*, Feb. 22, 1900, p. 135. The article is accompanied by a tabular and graphical presentation of the depth of silting at twenty stations, as measured in 1900, a map of the Colorado River and a curve and formula, the latter with derivation, showing rate of silting worked out in terms of depth on 1 sq.mi. Water flowed over the crest of the old dam for the first time in May, 1893. The dam was destroyed by flood on April 7, 1900.—Editor.]

Silting of New Lake at Austin—The contract for the present Austin dam was let in 1911 and the dam was partly filled by the summer of 1913. In September, 1913, the lake was filled with water up to the present spillway, which is 51 ft. above the toe of the old dam—the datum usually adopted. The dam, which has not yet been accepted by the city of Austin, has been in the hands of a receiver, Guy A. Collett, since 1916. In 1918 Mr. Collett, with the consent of the federal authorities, sold the water in the lake to the rice growers in the lower countries for the purpose of irrigating thousands of acres of rice on both sides of the Colorado River. This drained the lake.

In September, 1922, the writer cross-sectioned the lake at the old stations and found the results as shown by the accompanying table and diagram. In brief, the water storage capacity of the lake in 1922 was only a sixth of what it was in 1913. Making use of the author's formula for rate of silting in terms of depth on a base of 1 sq.mi. (for derivation, see *Engineering News*, Feb. 22, 1900, p. 135), in which $h(1 - x)^n =$ depth of water after n years, we have $h = 52.87$, and depth of water $= 8.53$. Hence $52.87\ (1 - x)^9 = 8.53$ or $(1 - x)^9 = 0.1616$. Hence $x = 0.1834$. That is, on an equal base, 18.34 per cent of silt was deposited each year on the average.

Historic Floods at Austin—The biggest floods of which we have knowledge are those of 1843, 1852, 1869,

1870, 1900 and 1913. The discharge of these floods has been estimated but no reliable measurements of any of them were made except of 1900. The following notes on these floods will be confined chiefly to that of 1869, although brief comments on some of the other floods and some general comparisons will be given.

Flood of 1869—The flood of 1869 is referred to by old settlers in Texas as the greatest in the history of the Colorado River. The writer has gone to considerable trouble to find accurate data in regard to this flood and submits herewith extracts from the diary of E. C. Bartholomew who has been a resident of Austin since 1867.

Wednesday, July 7, 1869: The Colorado River is tremendously high and causes great excitement. The people living on the bank are nearly all moving, and many houses are under water. Monroe Swisher's house across the river floated off, as well as other houses of an inferior class. Fields of cotton and corn on the river bottoms are covered with water, and the loss is immense. It has rained steadily since last Saturday night (July 3, 1869) until today. The river rose into the Davis large mill (Zilker ice house) on the bank of the river.

Saturday, July 17, 1869: We received the first Northern mail this morning in 13 days. The flood prevented the running of stages.

Capt. W. C. Walsh, another old resident whose home in 1869 was between Barton Creek and the Colorado River, states that the heavy rains began at 4 p.m. on June 27, 1869, and continued until about 3 a.m. of June 28, when the back water in Barton Creek was approximately 30 ft. deep. The rains continued through June 29 and 30, light showers alternating with heavy downpours. Rain began falling again on Saturday, July 3, and continued until the morning of July 7, when the maximum flood occurred. On the morning of July 7 the water was about 6 ft. deep at the gateway that leads to the present Barton Springs park.

The flood of 1869 is regarded as the biggest flood that ever occurred in the Colorado River, but E. C. Bartholomew distinctly questions whether the flood of 1869 was greater than the flood of April 7, 1900, that broke the Austin dam. There was a ferry across the Colorado River at the foot of Congress Ave., where the present reinforced-concrete bridge exists. Old settlers unite in stating that there was a high bluff from the present concrete bridge to the railroad bridge of the International & Great Northern Ry. This bluff was composed largely of alluvial deposits and was nearly as high as the present north bank. The flood of 1869 cut down this high bank on the south side, and eroded the plateau south of the bank for many feet.

Thus, the flood of 1869 and the flood of 1900 were passing through channels whose cross-sections were entirely different and there is no basis of comparison.

Flood of 1870—Quoting again from the diary of E. C. Bartholomew, this time under date of Monday, Oct. 17:

It rained hard all night, and when I arose this morning the river was up nearly as high as it was one year ago last July. The water carried off the pontoon bridge, and has caused great destruction on plantations below.

Studies at Webbersville of 1869 and Other Floods—Because the flood of 1369 changed the cross-section of the river at Austin, the writer made a special investigation of the floods at Webbersville on the Colorado, eighteen miles below Austin. At this place, the cross-section has remained practically constant. The village of Webbersville is situated on the north bank of the Colorado River, and the old settlers there were in all the floods since 1868, and the writer is able to make the following definite report:

RESULTS OF SILT SURVEY BEHIND NEW DAM AT AUSTIN, TEXAS SEPTEMBER, 1922

Station and Distance from Dam		Depth of Silt as Measured in Feet			
Name	Miles	Mean 1913	Mean 1922	Maximum 1913	Maximum 1923
Dam	0.0	36.10	14.44	60	19.00
Bee Creek	0.2	36.57	11.33	60	16.00
Mormon	1.2	29.91	6.13	57	12.20
Dry Creek	3.0	30.00	3.70	47	6.80
Bull Creek	4.0	29.43	3.60	38	6.40
Ennis	5.6	32.25	4.21	38	7.00
Devils	7.0	31.08	5.54	38	6.80
Ogarita	7.8	27.29	4.89	36	6.30
McNeill	9.3	26.83	4.70	31	6.20
Scotts	10.4	22.00	5.22	31	8.00
St. Monica	13.7	19.62	2.80	21	5.20

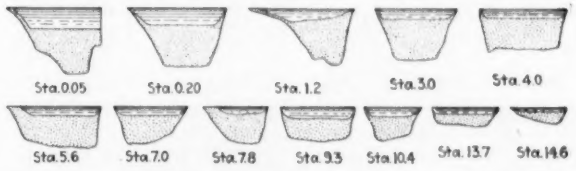
	Cubic Yards	Acre-Feet	Feet Depth on a Square-Mile Basi
Volume of water in 1913	54,591,680	33,745	52.87
Volume of water in 1922	8,805,280	5,456	8.53

Ratio of water volumes, 1922 to 1913 = 0.1616 or 16.16 per cent; or in the nine years from 1913 to 1922 Austin Lake has filled 83.84 per cent of its 1913 volume leaving a water volume only one-sixth that of 1913.

The flood of 1869 flooded Webbersville to a depth of 9 ft. and covered the farms to the foot hills, on the north, a distance of 1 to 1½ miles. The flood of 1870 was 3 ft. deep in Webbersville, and, therefore, 6 ft. below the flood of 1869. The flood of 1900, that washed away the Austin dam, did not get out of the banks of the river at Webbersville on the north side. The flood of December, 1913, was about 1 ft. higher than the flood of 1900. Therefore, in order of magnitude, the floods stand: 1869, 1870, 1913, 1900, 1899. The writer was unable to get any data in regard to the floods of 1843 and 1852.

During the flood of 1869 all the creeks between Austin and Webbersville were at flood stages, and therefore added their volume to that that passed Austin. However, the flood of 1870 came like a thief in the night, reaching Webbersville and overflowing farm lands while the farmers were working their fields. The 1870 flood came from the upper reaches of the Colorado River.

Flood of 1899—Although no reliable measurements of any of the floods were made, except that of 1900, calculations can be made for the flood of June, 1899. The old Austin dam had a rounded crest 1,091 ft. long, and



RELATIVE DEPTHS OF SILT AND WATER BEHIND AUSTIN DAM IN SEPTEMBER, 1922

The stations are given in miles above the dam. See table for depths in feet.

we could apply Francis's weir formula to the calculation of the discharge. The coefficient in the Francis weir formula is 3.33 but it is a well-known fact that this increases as the depth increases and the writer is of the opinion that in the case of the Austin dam this coefficient was nearer 4 than 3.33. A coefficient of 4 in the Francis weir formula will give a discharge of 160,000 sec.-ft. for the flood of April 7, 1900. It is to be recalled that this flood was produced almost entirely by the rains that fell in the Canyon section, between Marble Falls and Austin. The heavy rains

began at 6 p.m. on April 6, 1900, and continued for about twelve hours steadily. At 11:20 a.m., April 7, 1900, the old Austin dam cracked, and soon portions of it were washed away.

Low Flows of Colorado—In 1910 and 1918 the Colorado River reached its very lowest flows of recorded history. In 1910 the writer measured the flow at the dam from Aug. 15 to Sept. 28 and found it to be only 21 sec.-ft. In 1918, after the water had been drawn from the lake, the whole flow of the river plowed a narrow furrow through the silt above the dam, and the channel was so narrow that it was easy to hop across it at one jump. At this time the whole discharge of the Colorado River was only 9 sec.-ft. immediately above the dam, the flow being confined to a channel about 4 ft. wide in the silt.

Shaded Topographic Maps Are Developed by Geological Survey

WITH THE RECENT production of a shaded topographic road map of the region of Washington, D. C., the United States Geological Survey has made a further step in attempts to improve the legibility of its regular topographic maps by the use of shading. A section of the Washington map is reproduced herewith, reduced to one-half the scale of the published map (Fig. 1). An example of a different style of representation, a combined contour line and shaded map, is also shown (Fig. 2).

For a number of years the survey has been experimenting with various types of shading for showing relief both by itself and in connection with contours. The combination of shading and contouring, as exemplified for the Monument Spring section in Fig. 2 herewith, is considered to be well adapted to use for regular engineering purposes. A number of sheets in West Virginia and Pennsylvania are in course of preparation, and it is intended to publish them in the near future as a means of securing an expression from users of topographic maps as to the value of this method of showing relief. If opinion is favorable, other maps in

FIG. 1—PART OF SHADED ROAD MAP OF WASHINGTON AND VICINITY

One-half actual size. A greenish gray was used for the topographic shading, red for through roads (heavy lines), black for minor roads (fine lines), and blue for water.

various parts of the United States will be produced as demand requires. The extent of the work necessarily will depend on funds available. The same remarks apply to the method of representation used for the Washington road map, in which surface contours are not considered necessary.

The Monument Spring map was prepared under the supervision of J. H. Renshawe, of the Survey, an expe-

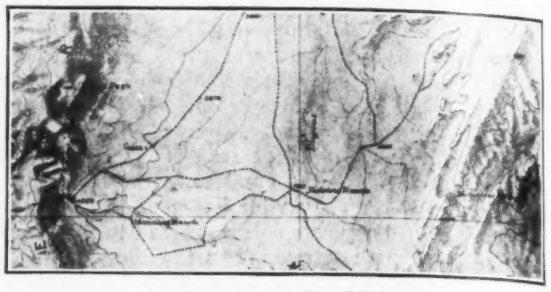


FIG. 2—CONTOURS AND SHADING COMBINED

Part of Monument Spring quadrangle, Brewster County, Tex., reproduced one-half original size. The contours are in brown as on the ordinary topographic maps of the U. S. Geological Survey. A brown stipple is used for the topographic shading, which is so applied as to give the effect of shadow under illumination from the upper left.

rienced topographic engineer and also an artist. The shading is so applied as to produce the effect of a sculptured relief model under oblique illumination. The aim of the artist was to bring out the character and individuality of the different topographic features, so far as the limitations of the scale would permit. The map further embodies an attempt to express differences in altitude by gradation of the shading tint, dark tints being employed for low lands and lighter tints for high lands. The use of hard lines was avoided, and a soft mellow effect was sought, so as to bring out the outstanding features in correct proportion, to enable the map reader to visualize the country at a glance.

Where standard topographic contoured maps exist, the work involved in preparing the shaded copy for combining with the contouring is not costly. The shaded copy can be prepared in a few days by a trained cartographic artist at an expense of approximately $70 for a standard topographic sheet, and the additional cost of mechanical reproduction would not exceed $75 a sheet for the ordinary editions.

The Washington area was selected for the purpose of bringing the question of shaded road maps for regions near large cities to the attention of road users. No additional field work is involved in producing the shaded map, and no great additional cost in applying the shading and in printing. It is expected that the result will prove to meet the requirements of tourists and automobile users far better than the ordinary road maps without relief.

Where the topographic survey of a state has been completed and published maps exist, a shaded relief map on the scale 1:500,000 will be prepared. The best example of a shaded map of a state that has been completely topographically mapped is that of Ohio, and the results obtained by Mr. Renshawe on this map may be considered as a standard of what can be expected for other states as rapidly as the topographic surveys are completed.

Expressions of opinion concerning these two types of shaded maps are desired by the director of the U. S. Geological Survey.

Reclaimed Rubber Tires to Be Tested

An order for fifty tires made with various amounts of reclaimed rubber in the tread has been placed with one of the rubber companies by the U. S. Bureau of Standards. These tires, when completed, will be tested in the laboratory and also on trucks of the post office department on four different types of road, to determine the relative wear resistance of the different compounds.

Inadequate Design Causes Failure of Concrete Swimming Pool

Structure at Midland Beach Resort, Costing $63,000, Damaged Through Collapse of Sidewall When First Filled

LACK OF adequate engineering design was apparently behind the failure, on July 3, of a reinforced-concrete swimming tank at Midland Beach, near New York City, built by the owners of the resort, and scheduled to have had its opening on July 4. The tank had been constructed hastily and was being filled with water for the first time when about half of one of the side walls pushed out, shearing off along the line where the side wall joined the floor slab. Property damage sustained through flooding was estimated at several thousand dollars.

The tank was built upon filled marsh land and was supported on timber piling. The structure, of rectangular shape with semi-circular ends, has a length of 200 ft. and a width of 83 ft. It was to provide for a water depth of 3 ft. at the shallow end, with the bottom sloping to provide a 11-ft. depth at the deep end. Concrete slab and side walls are about 12 in. thick.

FIG. 2—VIEW OF COLLAPSED PORTION

Inspection of the tank after failure would indicate that the greatest structural weakness lay in the lack of buttressing or counterforts to resist the heavy pressure of water exerted by a filled tank. As the photographs indicate, the structure is built in such fashion that the side walls merely rested on the slab, an attempt having been made to tie slab and walls together by bent ⅜-in. deformed bars. There appeared little uniformity in the spacing of the bars. When the side wall fractured it failed along the top of the slab, the slab under the inside half of the wall being left clean after failure.

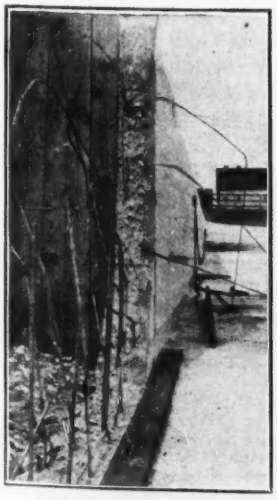


FIG. 3—CLOSE-UP OF REINFORCEMENT

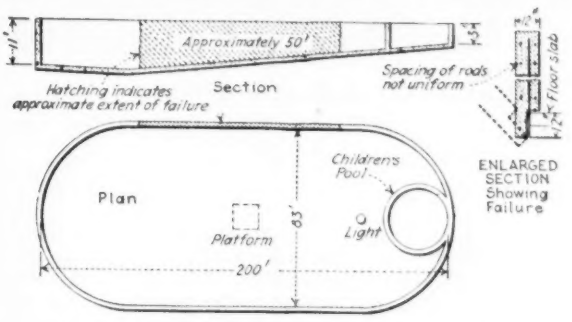


FIG. 1—PLAN OF POOL AND SECTION OF WALL

Lack of adequate design was also apparent in the failure to provide expansion joints. There was no provision for expansion longitudinally though laterally several straight cracks clear across the slab were apparent.

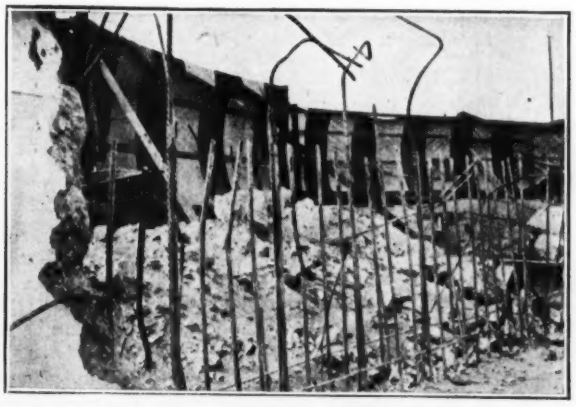


FIG. 4—REINFORCING CLEANED OF CONCRETE

The concrete used in the construction of the pool seemed to be run from bank run gravel and sand and no effort seems to have been made either to accurately measure it or exercise care in running the batches.

Competent advice was sought when the project was first proposed and a preliminary sketch was submitted by a reputable architectural and engineering office, but the owners for some reason did not retain the original designs although the layout was followed to a considerable extent.

The pool was built by the Midland Beach Co., at a cost of $63,000, James C. Hinchcliffe of Paterson, N. J., representing the owners. It is practically a dead loss as there are indications of failure in other parts of the construction.

Interchange in Formulas

An error in checking the formulas in the article "Trapezoidal Portal and Eccentric Heel Joint of Truss," by Camillo Weiss, printed on page 339 of the issue of August 30, interchanged the formula for moments M_A and M_B in two cases. The formulas for M_A and M_B below the middle of the first column, and the corresponding simplified formulas near the top of the second column, should have the right hand expressions interchanged, or they can be made to read correctly by writing M_B for M_A and vice versa. The formulas as still further simplified near the middle of the second column are given correctly in the printed text.

Two Precast Concrete Bridges on Lackawanna R.R.

One Carrying Railroad at Millburn, N. J., Made Up of Heavy Slabs Replaced Under Traffic Lighter Steel Structure—Other 48-Ft. Footbridge Over Three-Track Right-of-Way

By M. Hirschthal
Concrete Engineer, Delaware, Lackawanna and Western R.R., Hoboken, N. J.

In the design of railroad structures replacing those in use the main consideration is to cause a minimum disturbance of traffic. This factor frequently far outbalances economy in the design of the structure itself, for the difference in the cost of track work or temporary construction for two different types of design may constitute a large percentage of the total cost of construction. To eliminate interference with traffic and

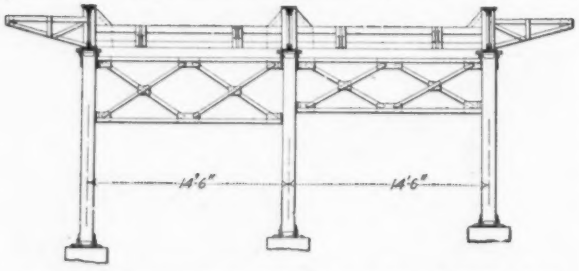


FIG. 1—SECTION THROUGH STEEL BRIDGE REPLACED AT MILLBURN, N. J.

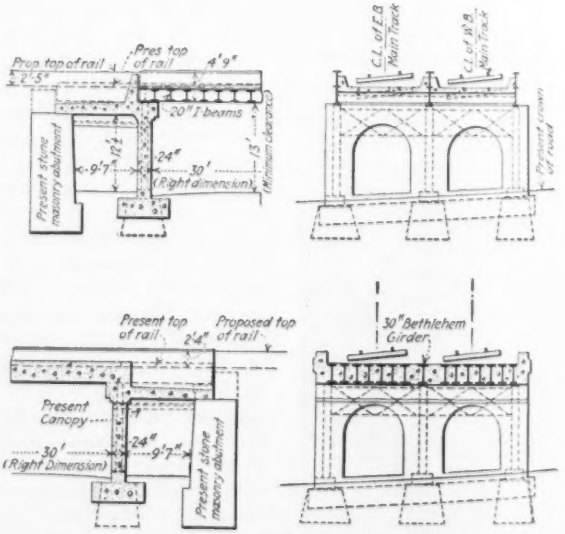
yet obviate the necessity of temporary construction, precast reinforced-concrete members have often been designed but with limitation as to spans, loads, and type of structures. Methods to extend these limitations to the point of almost removing them have recently been used with highly satisfactory results on the Lackawanna R.R. in two interesting examples of precast reinforced-concrete bridge work. The two structures to be described are the extremes of bridge work, the one a railroad bridge to withstand locomotive loadings as an undercrossing, the other an overhead footbridge.

Millburn Undercrossing Requirements—The undercrossing is a replacement of a structural steel bridge at Main St., Millburn, N J., on the main line of the Morris & Essex Division, subject to the heavy suburban traffic between Morristown and Hoboken. In 1894 this structural steel bridge, an unusual type, was built to provide for two tracks and station platforms, the latter by means of brackets cantilevered from the fascia girders which were each spaced 14 ft. 6 in. c. to c. from the center girder. All of these were through girders supported on steel columns (braced by latticed struts) along the curb lines and masonry abutments along the street lines. The floor beams, spaced 5 ft. 11 in. c. to c. were supported on the lower flanges of the girders while the stringers consisting of two channels back to back were framed into the floorbeams at different levels to take care of the superelevation required for the 4 deg. curvature of track compensated. The ties were placed on the stringers to form an open floor leaving the roadway span unprotected. The sidewalks, however, were protected by wooden canopies spanning from the abutment to a channel connected with the columns. Fig. 1 shows the old structure.

Some ten years later the station was moved about a thousand feet further east, dispensing with the platforms and permitting the removal of the brackets, thus reducing the loads on the girders, which were then being overstressed by the increase in locomotive loadings. These loadings however continued to increase and it became necessary to replace the structure by one more modern to meet future requirements. In 1921 plans were prepared for such a structure. The first type to be considered was one similar to that to be replaced, with the exception that the sidewalk spans were to be of concrete and the main bridge floor solid, as in the section in Fig. 2. The girders were to be supported on concrete arched piers encasing the then present columns, which construction also carried the sidewalk slab and necessitated the through girder construction over the roadway only. This scheme was discarded for one which dispensed with the use of the through girders, consisting of a floor of 30-in. Bethlehem girder beams spanning the roadway and spaced about 2 ft. centers, filled solid with concrete to form a 36-in. solid floor (Fig. 3).

Type Selected—The final variation was the substitution of reinforcing steel for the Bethlehem girders, which could only be accomplished for that thickness of slab by the use of compressive reinforcement, thus making the structure a reinforced-concrete bridge. The substitution reduced the weight of the slabs sufficiently for the handling of larger units as precast slabs.

The clear roadway span which is maintained in the present design is 30 ft. measured at right angles to the center line of street which makes an angle of 79 deg. with the tangent to the center line of tracks and result-



FIGS. 2 AND 3—TWO STUDIES OF PROPOSED NEW BRIDGE, BOTH REJECTED

Both designs incase old steel supports in concrete. Fig. 2 shows new steel girder bridge with 20-in. floorbeams and solid concrete floor, with reinforced-concrete spans over sidewalks. Fig. 3 substitutes solid concrete main span, of Bethlehem beams incased in concrete.

ing in a skew span of 30 ft. 7 in. The track centers are also maintained at 14 ft. 6 in., requiring two 7 ft. 3-in. slabs to carry the load of one track (Fig. 4).

The various portions of the structure were designed to carry an E-65 engine loading. For this condition of loading a slab simply supported, reinforced for tension and shear only, would have required a depth of 49 in. for the roadway span. Since the depth was limited to 36 in. the deficiency in the compressive resistance of the concrete for the latter depth was compensated for by the use of compressive reinforcement in the upper plane of the slab, with the required additional tensile reinforcement in the lower. Twenty-four 1¼-in. square bars were required for compression and twenty-five for tension to resist the maximum moment at the center of span. After the quarter-point of the span was passed, the steel was reduced to take the moment at that point. Two lifting loops of 1¼-in. round rods were imbedded at each end of the slab for handling both in loading on the cars and for setting in place. To provide for the maximum shearing stresses seven of the tension bars were bent up near the supports and stirrups of ⅜-in. rounds were spaced as shown. The parapet slabs for the main span are of sufficient depth to require no compressive reinforcement to resist moments due to the load they were designed for. The parapet slabs for the sidewalk spans were precast as a convenience in construction.

The piers were designed to take the maximum live-load reaction together with that of the dead-load and impact, the arched girders being reinforced both by the strut angles and reinforcing bars to transfer their loads to the concrete columns encasing the old ones of steel. The masonry footings were found to be sufficiently strong to carry the new loads, except that those at the ends were increased to provide for future third tracking. The pier is so designed that an addition can be made to accommodate the installation of a third track,

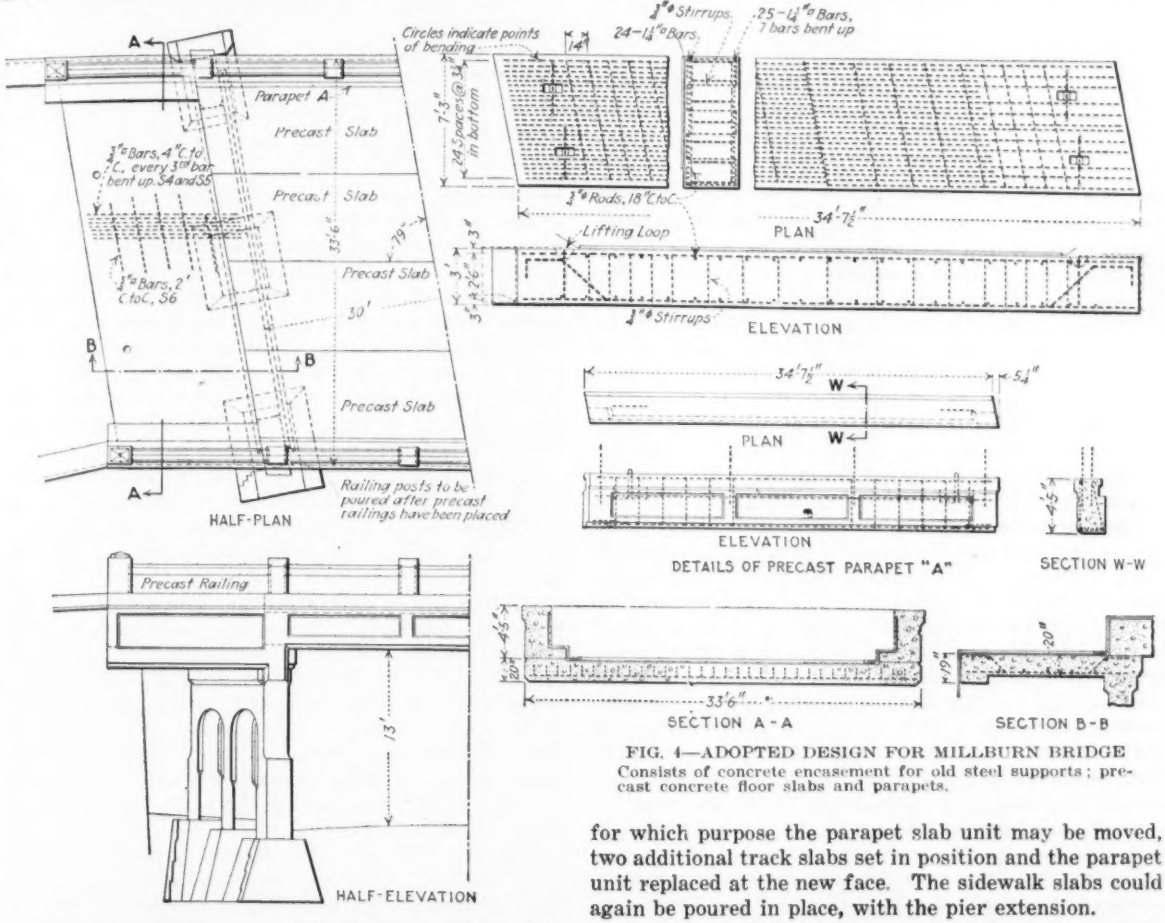


FIG. 4—ADOPTED DESIGN FOR MILLBURN BRIDGE
Consists of concrete encasement for old steel supports; precast concrete floor slabs and parapets.

for which purpose the parapet slab unit may be moved, two additional track slabs set in position and the parapet unit replaced at the new face. The sidewalk slabs could again be poured in place, with the pier extension.

Casting Methods—The precast units were cast in the yard of the shops at Kingsland, N. J., which is on the Boonton Branch. The forms were erected on a platform, the reinforcing steel was secured in position and the 1:2:4 machine-mixed gravel concrete poured. Two sets of forms were used and one track slab and one main parapet slab were poured in one operation. The concrete was cured in the open air and flushed twice a day for two weeks. All the slabs were treated in this manner and were cured at least thirty days before they were loaded on the cars for shipment to their destination. The weight of one track slab is 57 tons.

In order to expedite the completion of the work the precast slabs while still in the yard were waterproofed and a protection coat was provided to within lapping distance of each edge, the cloth extending a lap beyond the edge and being bent back pending erection, after which the cloth was bent back into position and the protection coat placed. The waterproofing for all the work consists of two plies of asphalt-saturated cotton cloth laid in asphalt and protected by 2¾-in. thicknesses of asphalt mastic.

The piers and sidewalk slabs however were poured

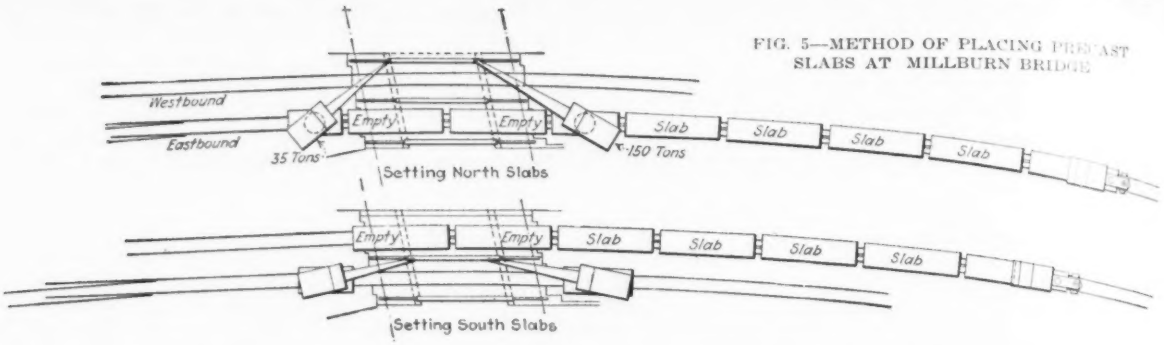


FIG. 5—METHOD OF PLACING PRECAST SLABS AT MILLBURN BRIDGE

in place without disturbing traffic either of the railroad or of the thoroughfare. The masonry of the abutments was removed to a point below the proposed level of the bottom of the sidewalk slab, the structural steel girders were blocked up a few inches to clear the sidewalk slabs, while the struts on the south half of the bridge, being too low, were cut off and replaced at the higher elevation as shown in Fig. 4. The forms were then built around the columns and struts as well as for the sidewalk slabs, the reinforcement placed in position and the concrete poured, each pier with its adjacent sidewalk slab comprising one operation, without interfering with traffic. These were allowed to cure for a month before the precast units were placed in position.

Erecting Millburn Bridge—The process of erection of these slabs was as follows: The precast units were loaded on flat cars at Kingsland, N. J., and transported to the site of the work at Millburn, N. J. It was planned to complete this erection and the raising of the track between the passage of the westbound train at 11:33 p.m. Sunday, and that of the eastbound at 4:11 Monday morning, or within a little more than four and one-half hours. It was decided to install the westbound track first because of the superelevation, therefore this track was cut east and west of the limits of the bridge while a work train was located on the eastbound track, as shown in Fig. 5. The work train consisted of the cars on which the slabs were loaded, a 150-ton wrecking crane, empty cars and a 35-ton crane. The floorbeams of the westbound track were cut free from the center girder, and, together with their fascia girders, each sidewalk span was lifted by the respective cranes into the empty cars which were then drilled out of the way and replaced by two other empty cars, with the cranes located on either side so that together they could lift the main span (fascia girder and floor beams) and load it onto the cars. The smaller crane was then drilled into the switch while the remainder of the train was manipulated so that the wrecker was located east of the cars containing the track slabs, after which the smaller crane was again shifted into position west of the cars, enabling both cranes to handle the units which were then placed in position clear of the center girder and tracks blocked up to new level 2 ft. 6 in. above the old.

FIG. 6—THE FINISHED PRECAST CONCRETE BRIDGE AT MILLBURN

It then became necessary to raise and ballast the track for a total distance of 1,800 ft. on both sides of the bridge, precluding the possibility of completing the eastbound track side of the bridge that night. The tracks at the bridge were then blocked up to permit of the completion of the waterproofing. Two nights later the work was resumed. The eastbound track was cut at both ends of the bridge, the wrecker located on the east end and the crane on the west while the train was so located that the empty cars were on the newly set span of the westbound track. The cranes then lifted the old steel sidewalk spans into the empty cars which were drilled out of the way; replaced by the other two empty cars into which was loaded the main steel span and these also were drilled out of the way. The cars containing the slabs were then located in position and the slabs, handled by the two cranes, were set in place and all of them aligned, the track was graded and ballasted on both sides of the bridge at which they were blocked up, traffic was resumed on both tracks and the waterproofing completed between trains. After all this the ballast was placed. The bush-hammering was then completed and a concrete balustrade cast in place, resulting in a structure as pleasing as one built in place.

East Orange Footbridge—The other example is a footbridge to replace one of structural steel, for Maple Ave., East Orange, in connection with the East Orange improvement described in *Engineering News-Record*, Nov. 9, 1922, p. 778.

This bridge consists of piers cast in place on top of the continuous retaining walls, which were built in connection with the depression at this point, the girders together with the slab spanning between them constituting the precast section. The stairways leading from the bridge at either end, like the piers, were built in place.

The piers carrying the footbridge are supported on the retaining walls and held in place by means of five 1-in. square bars imbedded in both walls and piers for a length of 3 ft. 6 in. in each, or about 40 diameters. The piers are 1 ft. 9 in. thick and somewhat more than

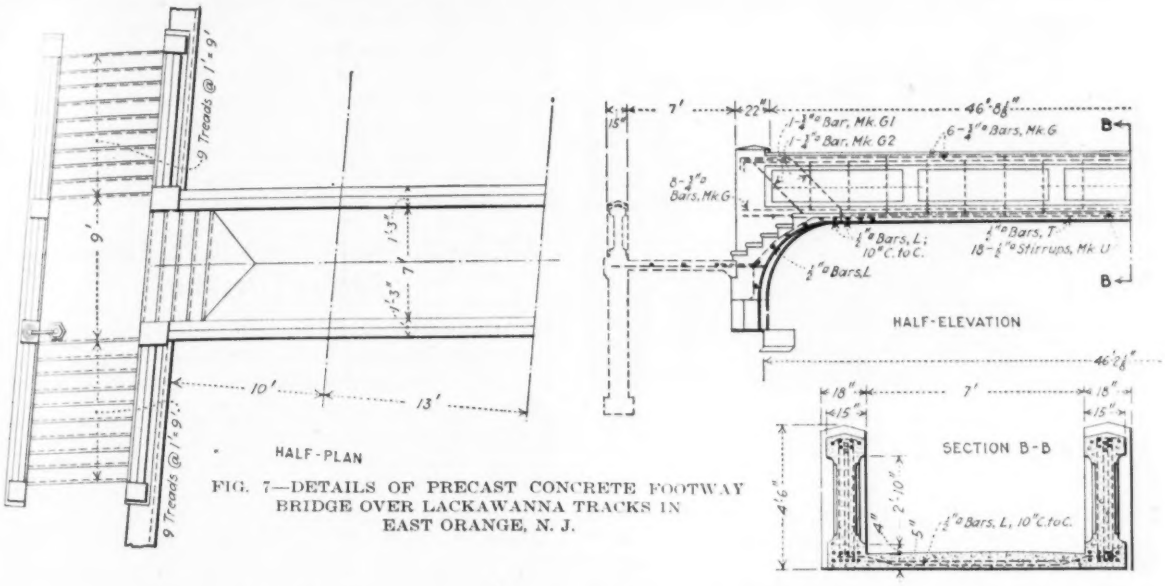


FIG. 7—DETAILS OF PRECAST CONCRETE FOOTWAY BRIDGE OVER LACKAWANNA TRACKS IN EAST ORANGE, N. J.

8 ft. high above the walls. These piers were poured more than a month before the footbridge was placed.

The interesting portion of the work is of course the precast section, which the writer believes to be the first instance of a complete reinforced-concrete bridge precast and erected on previously prepared piers. This footbridge is a single span of 46 ft. 8 in. over three tracks, the center lines of bridge and tracks forming an angle of 84 deg. 59 min. with each other, or very nearly a right crossing. It is of the slab and girder type, the slab being supported at the bottom flanges of the girders, which are located at the respective fascias and are somewhat ornamented for architectural effect. The clear passageway is 7 ft. wide, making an out-to-out width of 10 ft. at the end posts or 9 ft. 6 in. at other points. The fascia girders act as balustrades or railings and have a width of 1 ft. 3 in. both at top and bottom while the web between these flanges is only 9 in. thick except for the 1½-in. panel indentations. The floor slab is 6 in. thick along the center line or crown with a pitch of 1 in. to either side for drainage, which is further facilitated by a 2-in. camber resulting in a pitch toward the stairs at either end. Side clearances for the tracks below permit curving the soffit of the slab to a 4 ft. 10 in. radius at the junction, with the supports providing a curved corbel, thus permitting the introduction of the stair construction several feet before the supports are reached. The precast section therefore includes five risers of the stairway at either end.

The fascia girders 4 ft. 3 in. high result in 3 ft. 9 in. depth of railing, but this does not provide the required compressive resistance for the span, necessitating the use of compressive steel reinforcement, consisting of six ¾-in. square bars as shown in the cross-section. The

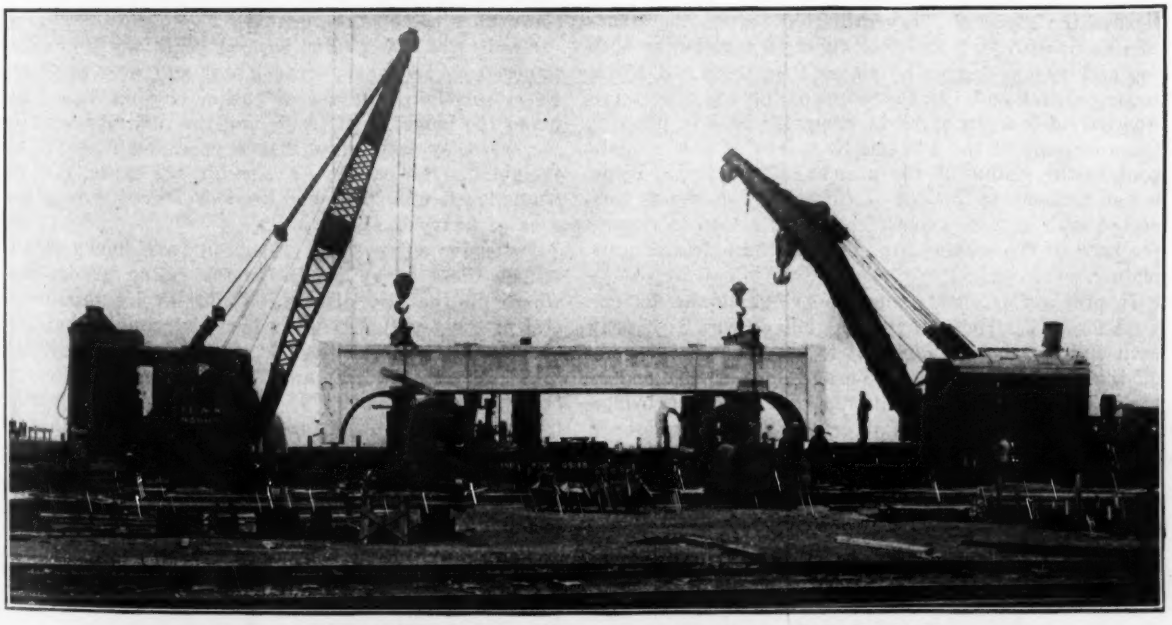


FIG. 8—LIFTING THE 57-TON CONCRETE BRIDGE IN THE CASTING YARD

FIG. 9—THE MAPLE AVE. PRECAST BRIDGE IN PLACE
The supporting piers have been built up from the retaining walls alongside the cut; the approach stairways have not been put in position.

tensile reinforcement consists of ten ¾-in square bars two of which are bent up to resist diagonal tension in addition to the vertical stirrups of ½-in. square section spaced 2 ft. 6 in. on centers throughout the length of the girders.

This footbridge was also cast in the yard adjoining the Kingsland shops. The forms were erected on a platform, reinforcement was set in place and concrete of 1:2:4 proportion with broken stone as the coarse aggregate was poured, of course, in one operation (the volume amounting to less than 30 cu.yd). After the forms had been removed and concrete sufficiently hardened the panels formed by the indentations were bush-hammered, and the bridge was ready for transportation to the site of the work.

To insure against any damage to the bridge in the various operations incident to final erection and to facilitate handling, a combination of spreader and cradle was devised, to encircle the structure at points adjacent to the curved sections near each end. Each of these cradles consisted of a pair of 15-in. I-beams side by side, both under the soffit of the slab and above the tops of the girders. They projected beyond the structure sufficiently to permit bolting them together at both top and bottom flanges by plates 1 in. thick and 15 in. square at each end. At the center of this spreader there was provided a pin of 3¾ in. diameter held in place at the underside of the I-beams by means of a 1-in. plate bent to the radius of the pin, the flat portions being bolted securely to the two I-beams. This pin was connected with a 3-in. eyebolt ending in a loop to engage the hook of the crane. Fig. 8 shows these details quite plainly.

In preparation for setting the bridge on the flat car used for this purpose, a timber grillage was built near each end to a height sufficient to keep the curved ends off the floor of the car. Two cranes, one at each end of the bridge, each engaged a lifting loop, raised the bridge from its platform and set it on the flat car in proper position. The train including the cranes then moved to East Orange via the Bergen Hill Tunnel at Jersey City. The bridge was set on its supports by the two cranes, in the same way it was loaded on the cars in the hour between 1 and 2 a.m. after the last westbound suburban train had passed.

In the design of both these structures the unit stresses, similar to all other work on the line, were 650 lb. per square inch for concrete in compression, 16,000 lb. per square inch for steel in tension and 100 lb. for adhesion between steel and concrete; the stress in the compressive reinforcement is of course much below ordinary allowable limits, being fifteen times that of the concrete at the section of its embedment or in the neighborhood of 7,500 lb. per square inch. The weight of the precast bridge is 57 tons.

Oregon Short Line R.R. Improves Idaho Division

Relocation, Grade Reduction and Double Tracking for Tonnage Trains—Pusher Sections Reduced—Construction Work

DOUBLE TRACKING and grade reduction on pusher grades of the Oregon Short Line R.R. near Glenns Ferry, Idaho, are being carried out to effect material improvements in operating conditions on the two freight districts of the Idaho Division, extending between Pocatello, Idaho, and Huntington, Ore., a distance of 326 miles. Except for the two pusher sections of 2 and 1.72 per cent grade these districts have very favorable grades. The work includes a 26-mile stretch of double tracking between King Hill and Reverse, two sections of relocation of the second track and the improvement of the freight yard and engine terminal at Glenns Ferry, which is the intermediate district point. Between Pocatello and Huntington the line is equipped with block signals.

From the general and detail plans and profiles, Figs. 1 and 2, it will be seen that Glenns Ferry, the district terminal for freight runs, lies in a deep sag in the grade line. From it the maximum ascending grades are 1.72 per cent eastbound and 2 per cent westbound. Elsewhere on the division the ruling grades are 0.5 per cent except for about 102 miles between Glenns Ferry and Minidoka, where the ruling grade is 0.65 per cent for eastbound traffic on both the main line and the North Side branch (see Fig. 1). All permanent improvements on the division are being made to conform to these ruling grades.

Grade Reduction—For several years the limitations imposed by the heavy grades east and west of Glenns Ferry, involving the use of pusher engines, have hampered the handling of traffic and the difficulty has been increased by lack of adequate yard facilities at this freight district point. As a result, the capacity of the single-track main line has been overtaxed during seasons of heavy business.

Extensive surveys for relocation have shown that to reduce these heavy grades to the ruling grades elsewhere on the two districts would involve prohibitive cost of construction. It has been determined therefore to retain the short pusher sections from King Hill to Ticeska on the east and from Hammett to Reverse on the west (see Fig. 2) but to reduce their grades to such an extent as to facilitate the handling of standard tonnage trains.

At present, the ruling grade eastbound from King Hill east to Ticeska is 1.72 per cent, but the second track will be constructed in part on a new location with a maximum grade of 1.5 per cent at a cost no greater than that of double tracking on the present location. The diversion will be about a mile in length and at a maximum distance of 450 ft. from the present main line. This

improvement will not involve any material increase in distance. With this reduced grade the standard 2,200-ton train load can be handled eastward from Glenns Ferry to Minidoka (ruling grade 0.65 per cent) with the assistance of a pusher engine of the same tractive effort as the road engine between King Hill and Ticeska, a distance of only six miles. At Minidoka trains may be filled out to the 2,600-ton standard rating for the ruling grade of 0.5 per cent eastbound to Pocatello, the branch line feeders from the south into Minidoka furnishing ample tonnage for this purpose.

Relocation and Double Tracking—Since prohibitive cost also prevents the reduction of the westbound maximum grade of 2 per cent to the ruling grade of 0.5 per cent, extensive surveys were made to determine the best location for a new westbound second track on a grade which would fit in with the use of pusher engines. These surveys resulted in developing a line which has a maximum grade of 1.45 per cent, shortens the distance by two miles, has a maximum curve of 3 deg. instead of 5 deg. and saves 54 deg. of total curvature. The saving in distance was secured by taking advantage of the slack grade between Hammett and Reverse and starting the ascent about one mile west of Hammett. This location was adopted for a new double-track section, with abandonment of the original line.

Heavy grading is involved by this new double-track diversion, although it has no bridges and except for one 10-ft. arch span the culverts are light. Owing to the cost of earthwork this improvement was not undertaken until the increasing traffic warranted the expense. Some of the grading quantities are noted on the profile, Fig. 3. In spite of the additional cost of constructing the second track on the new location, it is estimated that this improvement will result in high economy in operating expenses due to the saving in distance, the saving in first cost and operating expenses of interlocking plants and the preservation of right-hand operation of trains on double track. All towns and business in the district involved can be served as well by the new line as the old line.

With the completion of the work described above, in addition to the 15½ miles of double tracking between King Hill and Bliss, and the ballasting and laying of

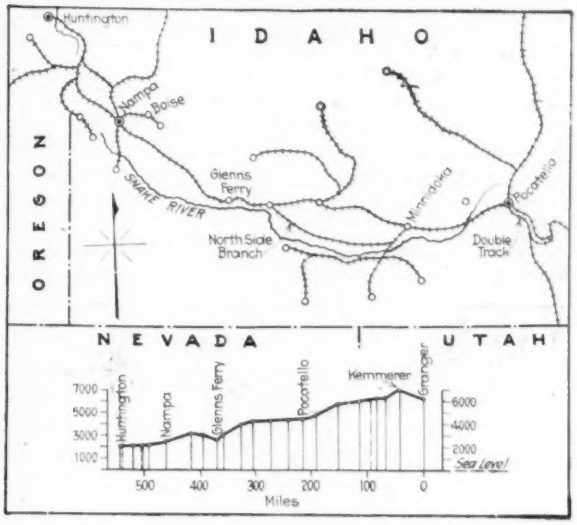


FIG. 1—OREGON SHORT LINE R.R. IN IDAHO

heavy rail on the North Side Branch (Fig. 1), the Oregon Short Line R.R. will have a continuous second track from Minidoka to Reverse, 123 miles. On the new work and in relaying the present track, 100-lb. rails of the A.R.A. section are used, with gravel ballast 15 in. deep under the ties.

Double tracking now under way covers the stretch between King Hill and Reverse, 26 miles. Work was started in June, 1922, on the section between King Hill and Hammett, and in November on the section between Hammett and Reverse. About eight miles from King Hill to Glenns Ferry was put in operation on Nov. 16 and the next stretch to Hammett was put in operation on Dec. 30, 1922. Since the line change between Hammett and Reverse, nine miles, involves heavy grading, this portion probably will not be completed until near the end of 1923.

Freight Yards and Engine Terminal—Two tandem freight yards for eastbound and westbound movements have been laid out at Glenns Ferry and between them is the engine terminal. At this point the two main tracks were laid on opposite sides of the 200-ft. right-

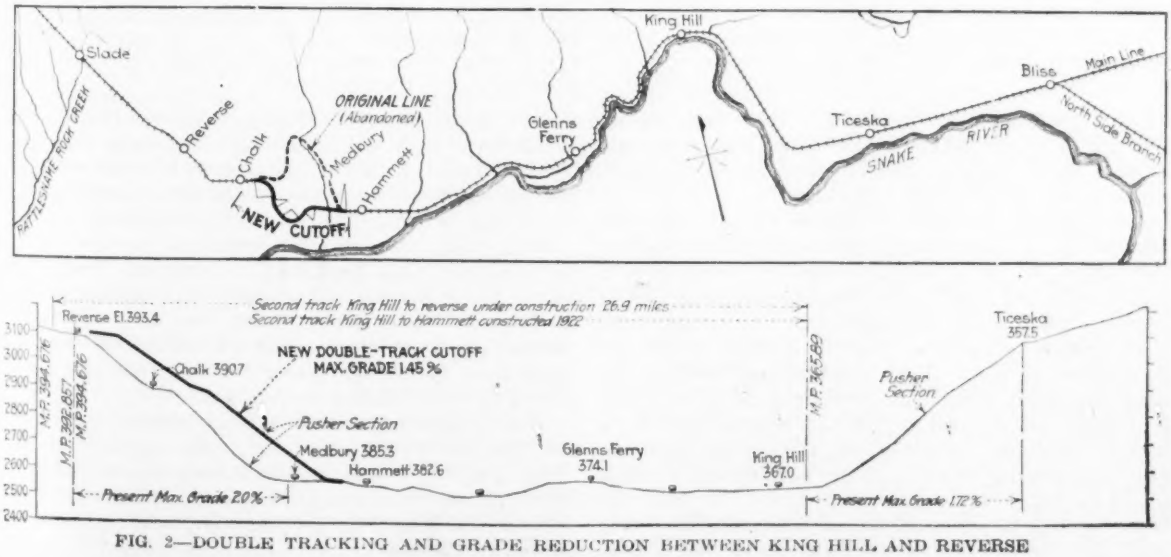


FIG. 2—DOUBLE TRACKING AND GRADE REDUCTION BETWEEN KING HILL AND REVERSE

of-way in order to permit ample development for the yard tracks and locomotive facilities. Daily freight traffic at this point averages 35 trains inbound and 35 outbound. Many of these are run through as solid trains, except for the change of engines and crews and the switching out of occasional bad-order cars. These yards are arranged for flat switching. In the ladder tracks No. 9 frogs are used, but the turnouts from main tracks have No. 10 frogs.

At the engine terminal a 100-ft. truss turntable serves a 17-stall roundhouse of brick and concrete. The ashpit is of the depressed-track type, with ashes shoveled by hand from the pit into cars on the depressed track. A new coaling station is to be built, having a bin of 650 tons storage capacity.

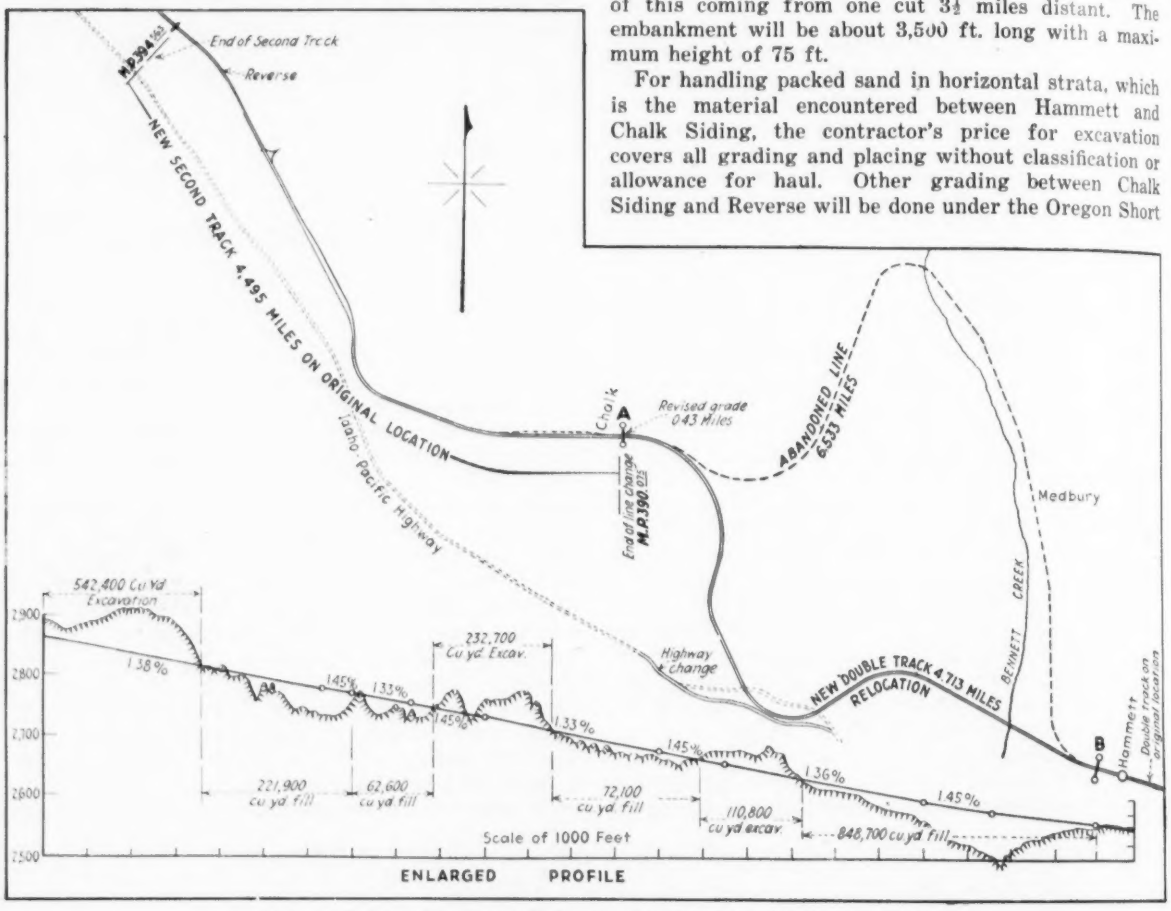


FIG. 3—PLAN AND PROFILE OF RELOCATION ON IDAHO DIVISION

Construction Methods and Plant—On this improvement work the grading outfit included five steam shovels with 2½-yd. buckets and one dragline excavator with 5-yd. bucket and 50-ft. boom. Teams and fresno scrapers were used also on the lighter portions of the work. Dump wagons served the dragline machine, which was used in one large cut. Both standard-gage and narrow-gage equipment served the steam shovels in cuts and in borrow pit excavation. Standard-gage side-dump cars of 12 cu.yd. capacity were used, while the 3-ft. gage equipment comprised 12-ton locomotives handling trains of ten 3- and 4-yd. dump cars. The haul was from 1,000 ft. to 18,000 ft. but on account of the heavy traffic on the existing single-track main line it was necessary to handle practically all construction operations without use of the main track. Fills were made by dumping from framed trestles having a maximum length of ½ mile and a maximum height of 50 ft.

On the four-mile diversion west of Hammett (see Fig. 3), the total yardage will be about 1,204,000 cu.yd., averaging 300,000 cu.yd. per mile in embankment. All of this material will be hauled from cuts, with the exception of about 300,000 cu.yd. from borrow pits. In the first mile west of Hammett a heavy fill of 848,700 cu.yd. will be built with material from cuts, a large part of this coming from one cut 3½ miles distant. The embankment will be about 3,500 ft. long with a maximum height of 75 ft.

For handling packed sand in horizontal strata, which is the material encountered between Hammett and Chalk Siding, the contractor's price for excavation covers all grading and placing without classification or allowance for haul. Other grading between Chalk Siding and Reverse will be done under the Oregon Short Line R.R. specifications, which provide classification for earth, loose rock, solid rock and lava rock, with 400 ft. free haul. Fills are required to be made with 10 per cent of the cross-section added for shrinkage.

Grading is being done by the Utah Construction Co., Ogden, Utah, and the new buildings for the engine terminal are being built by C. I. Anderson, Salt Lake City. The moving of stations and other small buildings at King Hill and Glenns Ferry was done by A. D. Moodie, Portland, Ore. All track and bridge work is being done by railway forces. A labor shortage from July 1 to Nov. 1 slowed up progress.

This improvement work is being carried out under the direction of R. L. Huntley, chief engineer of the Union Pacific System, and W. R. Armstrong, assistant chief engineer in charge of the Oregon Short Line R.R., with J. P. Elliott as assistant engineer in resident charge of the work.

An Interview

With HENRY H. WILSON
Managing Partner, Winston & Co., Muncy, Pa.

Overlooked Items in Estimating Road Work

By C. S. HILL
Associate Editor Engineering News-Record

Factors Affecting Costs Whose Neglect or Improper Evaluation in Estimating Turn Theoretical Profits Into Practical Losses

WHEN ESTIMATES are too low it is usually because either (1) all the items of cost are not considered or (2) some or all of the costs are not correctly evaluated or because both errors are committed. There probably never will be found a way of determining beforehand all the contingencies that affect cost, and there is even less chance of making a uniform and always correct appraisal of the sum that every contingency adds to cost. There must be always some guessing in setting prices for construction but that does not warrant wild and free speculation.

Qualifications for making correct estimates cannot be transmitted by gift. Neither is it possible to reduce estimating practice to a code. Judgment is a leading qualification which cannot be passed on by word, and conditions vary too much to be capable of expression in standard forms. Without, them, presuming to present a complete method of estimating—there being no such thing—it is possible to name some, perhaps a majority, of the factors influencing costs which are frequently overlooked in making estimates.

If a contractor would avoid overlooking important items entering into a bid, he must exercise, in its preparation, the same degree of industry and intelligence that he is willing and expects to exercise after the contract is awarded him. He should not overlook the fact that in estimating, "A little learning is a dangerous thing." It is unwise to accept the judgment of scantily experienced people on matters of vital concern in connection with his estimate. Also it is unwise to place too much reliance on the infallibility of the estimate made by the engineer in charge of the work, or, perhaps, any reliance at all on the estimates sometimes tendered by interested vendors. It is also well to avoid being influenced by figures which may have been submitted by other bidders on similar work at previous lettings. Costs of other contractors may be determined by factors one is incapable of measuring, with the information at his disposal; or possibly incapable of duplicating even under similar conditions, with his organization. A conservative policy to follow in estimating is to be unmindful of others who may be bidding and thereby avoid any possibility of allowing oneself to be influenced by what another may bid.

General Factors—An important consideration frequently overlooked by bidders is the adding of a percentage to their bids to cover the probability of having to assume many elements of risk and uncertainty, such as Acts of God, delays and suspensions of work by owners, unusual increase or decrease in contract quantities, absence of means for legal redress for inequities or arbitrary decisions. By the unilateral form of contract under which one is generally compelled to bid, the contractor may be penalized for one or all of the above contingencies. So long as this form of contract persists, it is imperative that bidders should protect themselves by adding to their estimated costs a proper percentage to cover probable occurrence of the above factors. No conservative business concern should assume risks without underwriting them. In one state, it was estimated in recent years, by a committee of representative contractors and engineers, that at least 15 per cent should be added to estimated costs to cover risks embraced in the form of contract in use.

Another general factor which should not be overlooked is, a decision in advance of bidding as to proper sequence of operations and the most satisfactory and economical equipment for performing them. Such a study may have great influence in reducing the volume of labor required or in increasing the amount of machinery.

With the heavy advances in freight rates, in recent years, and the constantly increasing tendency to substitute machinery for labor in road building, freight on plant has become a formidable item of expense on almost every road contract. With a scarcity of labor and the resulting unrest in its ranks, losses due to transportation advanced often assume serious proportions and should be carefully approximated. The total cost of such items as leases, rentals, camps, warehouses, traveling expenses, legal expenses, demurrage charges, telephone and telegraph bills, compensation, fire and public liability insurance and interest charges, is impressive and none of these items should be overlooked. In estimating interest charges, thought should be given to probability of delay in payment either on monthly or final estimates and also to whether or not allowances will be made for materials stocked on the work.

With the increasing size of road contracts and the growing practice of letting contracts throughout the year, increasing volumes of work have to be carried over the winter into a second season. The additional cost is an important estimate item. Again, in using previous costs, consideration must be given to whether these costs were achieved under the direction of a more competent superintendent and a more efficient organization than is likely to be available for the work in hand. Other items which have to be considered are soil and topography, right-of-way, and structural obstacles in their relation to wet weather, transportation and the probable duration of the working season for the locality.

The probable character and ability of engineers and inspectors should not be overlooked. In a particular state highway department, one will often find considerable variation in this matter and a consequent reaction on costs. If there are many engineering complications on a contract, one may encounter considerable delay and expense if the engineer is inexperienced, procrastinating or too busily engaged with other contracts to give one's problems prompt and conclusive attention.

It is well, first, last and always, to remember that there is as much in conditions as there is in prices. Successful estimating is as often the result of one's skill as a phophet as it is a matter of his industry.

Labor—A common oversight in estimating is the careful appraisal *for the period of operation* of the supply of labor and, as determined by this supply, the trend of wages. Last year road contractors who put in early-season bids, underestimated the season's average rate of wages. One wonders if they have not done so again this year. It is true indeed that wages and labor supply are hard to foretell, but the wise bidder will make some attempt at a valuation of both.

Some of the questions to which answers need to be secured are: Is there a local supply of labor? Is this supply normally consumed later in the season? Will there be other local construction operations to compete? Is the labor resident or transient? Are there nearby large cities to draft labor, to reflect quickly wage changes, to magnify union influences and to encourage unsteadiness and turnover? Are there living accommodations for imported labor? Finally the general market for construction labor has to be taken into account. It is to be noted again that it is the *average* wage rate for the period of the operation that the estimator needs to know.

Experience and training are other factors in the labor problem by which costs are affected and, therefore, prices must be determined. Is the work to be done with an old experienced organization, or by a new organization created for the operation? The latter circumstance will increase the labor cost by a material percentage, particularly in the early stages of the work, (1) because the untrained crew will be longer in getting the outfit ready and squared to estimate-earning work and (2) because it will turn out smaller volumes until it becomes trained.

It should be borne in mind that, in a rising labor market, labor costs always increase in greater proportion than do wages, due to decreased efficiency of production. Tables kept by one contractor last year showed that, for every 10 per cent increase in wages, there was an increase of 16 per cent in the labor cost of production. It will be immediately apparent that this is a factor of vital significance to estimators and failure properly to evaluate it has made unprofitable many contracts taken on an apparently profitable basis. An additional factor, difficult of even approximation and, oftentimes, entirely overlooked, is the expense resulting from labor turnover in those years when there is a scarcity of labor and an almost constant necessity of breaking in "green" men in place of experienced ones. While hard to estimate, this may be a prolific source of expense. On one road contract last year, where the average working force was less than 100 men, more than 800 men were actually employed during the working season. Indirect or overhead labor, such as superintendence, office force, unloading, repairing, setting up, moving and removing equipment, is an item of expense easily underestimated, particularly where there is any possibility of failure to complete work withing the time estimated.

Transportation—The old habit of expecting railway transportation to be adquate has, in the last few years, been pretty well beaten out of contractors. Embargoes, car shortages, strikes and other influences of general operation curtailing railway service are being discounted. Local drawbacks are more commonly overlooked. This is unfortunate because these are the ones which it is most within the power of the contractor to appraise and overcome.

Some of the contingencies in transportation to be regarded are whether service is by a main or secondary or branch line; what the frequency and time of train movements are; whether the direction of light train movements is that in which job shipments will come; whether the local car and general freight-handling facilities are good; what additional sidings, unloading spaces and car moving equipment will be required; what the road conditions are to and from unloading points and railway distances to supply points.

Train movements are of vital concern. Carload shipments must be by regular trains and the frequency of these and when they come in determine arrangements which have to be made for receiving shipments. Generally secondary line service is best if the freight originates on the line; main lines are more apt to be crowded with higher classification freight which will receive preference, and branch lines have fewer available trains. Also generally better service is had if the shipments are in the same direction as light freight movement. The local carload freight handling facilities determine what the contractor will have to provide in the way of sidings and how much shunting and shifting he will have to do. Generally lack of means of handling shipments increases both the cost of receiving service and the inevitable demurrage charges.

Roads are another factor in transportation costs that frequently are overlooked with disastrous consequences. Not only the roads for getting materials to the operations of construction but roads to and about the unloading yards and even to the town and railway station where supplies are got and small shipments arrive have to be considered for all conditions of weather and with the loads to be hauled in mind. Underestimated costs properly to maintain roads serving the job have cut the paper profits of many a highway contract.

Materials—Taking the lowest bid for materials as a basis for estimating without knowing whether the dealer or producer can deliver as fast in the amounts wanted as is required and whether the material is of a quality that will be accepted by the inspector is a common error. Quality and regular delivery are the paramount considerations and the price should be fixed on this basis. On materials not bought on contract, a price has to be estimated with due regard for the probable trend of the market. Other items are the cost of storing, shifting and rehandling materials, and waste incident to these operations as well as to damage and accidental loss which cannot be avoided. Failure to provide waste insurance in the estimated prices of materials cuts into profits. It is pertinent to note here that adverse railroad conditions in recent years have strikingly demonstrated that stocking and rehandling large quantities of materials is less expensive than delays often resulting from lack of materials. Liberal allowance should always be made for stockpiling and rehandling expense which average experience indicates to be necessary for an uninterrupted flow of paving material to the job at all times.

Supplies—Proper consideration is not often given to the cost of supplies. Individually the items may be insignificant but the total always runs into a considerable sum. An item easily overlooked here is the cost of repair parts and shop work for machinery, which will vary greatly according to age and condition of equipment. Besides the actual prices paid and the amounts

required, there are freight and express charges and delivery expense for all supplies. The cost of handling numerous small quantities and articles is a larger amount than one imagines until the figures are totalled. Any contractor will do well to prepare lists of supplies, for particuar types of roads, using previous job records, and work out approximate figures for shipping and handling costs. Going over such details and figures, when an estimate is being made up, will often save an under-allowance for supplies.

Plant and Tools—It appears to be a natural habit to underestimate these items of expense. Extra gangs, changes in plans and misjudgment in co-ordinating operations are contingencies that must be anticipated and all of which add to the stock of equipment and tools required. As an example, the failure of a planned water supply may require additional development, pumping outfit and pipe line. Plant depreciation is one of the most troublesome items for the estimator and one on which there is room for considerable divergency of view. Where a contractor has been forced to make large purchases and immediately encounters a falling market, it accumulates added significance. Under these conditions, the first cost of a heavy plant investment might drop 33⅓ per cent during one season's operations. Assuming such a condition, the owner would be faced with a loss of one-third the value of his equipment, plus the depreciation upon the remaining two-thirds. Under these conditions, and under the small margin of profit on which highway work is bid, an otherwise profitable commitment might be thus turned into an unprofitable one.

Excavation Costs—Failure to study all excavation involved, in the field, and work out in advance of bidding an approximate classification of materials to be handled in grading foundations, ditches, borrow pits, shoulders, dressing slopes, refilling rock-breakage in cuts, etc., as well as the relative cost of each type of work is common. Because of the difficulty and expense necessary properly to keep such costs, we find not only contractors' records, but the actual technical literature in existence on this particular subject, very barren. After all care and skill have been exhausted, however, we are still forced to admit that any estimate upon road excavation will, doubtless, vary more widely proportionately from the actual costs experienced than the estimate upon any other item in a highway contract. Under these conditions, one might think that contractors would proceed with more caution and be less inclined to flirt with the danger line, in bidding on this item, than on any other item of a contract, but no such impression can be justified by the history of costs in recent years.

It is quite common not to estimate even approximately on the amount of fence moving, sod clearing, scarifying and other items which may be included in the excavation price, not to approximate average length of haul or overhaul on excavation and borrow, not to recognize that, on most road construction in cuts, it is impracticable not to excavate the shoulders of the road and then replace them without payment for either operation.

Other Contract Item Costs—In the same category with these oversights in estimating excavation is the common failure, in bidding on masonry work, to recognize the great variation in the unit costs of labor and other expenses, as between bridges, walls and other heavy masonry and pipe head walls, curbing, gutters, etc. Such items as head walls, bridge parapets, curbing and gutters will be comparatively much more expensive than other heavier types of masonry, not only in labor but also in waste of material. As an instance of this, on a road built in 1920, the cost of rubbing down head walls, with labor at $4.50 per day, was found to be 30c. per cubic yard of concrete.

In fixing prices on varying sizes of curbing, gutters, etc., many bidders apparently fail to recognize the basic fact that the smaller the volume of concrete, or other material, per linear foot, the greater will be the unit cost of handling and placing a cubic yard; of handling forms, finishing, protecting, moving equipment; of ratio of material waste. The same is true of excavation prices in that they sometimes appear to indicate a premise that excavation for tile drain, curbing and other small items can be done as cheaply as grading where quantities are large.

The cost of materials for pavements is usually a large part of the cost of a modern highway, hence the importance of adding to one's bid an ample percentage to cover waste and the labor expense in handling that waste. In some instances, highway departments and inspectors still insist upon the right to reject materials after unloading from railroad cars, without compensation to the contractor even though the burden may properly rest upon the material producer. As producers almost invariably refuse to accept responsibility for paving material condemned after unloading, it is proper to add a percentage for protection against this contingency where it is likely to be encountered. In some localities, it is essential for a bidder to protect himself against arbitrary decisions as to proportions of paving and other materials. In one state, in recent years, it was estimated that an arbitrary decision requiring contractors to give compacted measure on cement and accept loose, unshaken measure on aggregates, cost the contractors over $100,000 in a single working season. Recognition of this hardship was refused and no legal means of redress was possible under the form of contract in vogue.

Care should be exercised not to overlook figuring shrinkage as between loose measure and solid measure in the construction of sub-base, broken stone base and other foundation courses.

Conclusion—In conclusion, it may be said that there is no "royal road" either to the best estimating or to preventing the disappearance of paper profits. To the close student of the subject, however, this fundamental thought should always suggest itself: *No matter how many uncertainties may enter into the preparation of an estimate, the moment you eliminate or neutralize one of these uncertainties by careful analysis and study, you are correspondingly closer to the actual result than if you guessed at them all.* As has been said before, no scheme will ever be devised or charts drawn so that a novice can make highway estimates. By the same token, nothing will ever be promulgated or known which will entirely eliminate the disappearance of paper profits. However, through use of brains, intelligent interpretation and application of previous costs, as well as a study and knowledge of conditions influencing costs, risks can be greatly minimized and a much more accurate and conservative result obtained than is possible by any other human method. Aptitude in estimating for all items of expense concerned in a job, will have to be built on experience and study in the actual conduct of construction.

Building Construction Courses in Engineering Schools

Details of the Thompson-Starrett Foundation at Yale and Union and of Proposed Similar Courses in England

SOME WEEKS ago it was announced that there were to be established at Yale University and Union College courses in building construction financed partly by a benefaction to be known as the Thompson-Starrett Foundation. The full details of these courses have not been worked out but there is given below a preliminary statement regarding each. The information about Yale is from Dean C. H. Warren, of the Sheffield Scientific School, and that about Union from Prof. F. P. McKibben. As a matter of collateral interest there is also presented an extract from a recent "London Letter" in the *Journal* of the American Institute of Architects, which notes the formation of somewhat similar courses in England.

Yale University Course—Through the generosity of Louis J. and Mary E. Horowitz, a very substantial sum of money has been placed at the disposal of the university to be used for defraying the expense connected with the establishment of a course which may serve to prepare young men for entering on a professional career in the field of building construction. To accompany his gift for the establishment of the course, Mr. Horowitz offers two very substantial prizes to assist worthy and capable young men in securing practical experience for a period of two years after graduation.

The receipt of this gift is of such recent date that the university authorities have not as yet had an opportunity to work out fully the details of the course. As outlined in a preliminary way, it is proposed, in accordance with Mr. Horowitz's wishes, to make the course in every way equivalent to the other engineering courses, with the expectation that graduates of the course will be prepared to enter upon work in the construction of modern buildings from a thoroughly scientific and engineering standpoint.

The course will be given under the auspices of the Sheffield Scientific School and will be associated with the Department of Civil Engineering. The study of architectural design will be in the hands of the Department of Architecture in the School of Fine Arts, and it is expected that students in architecture will be given the opportunity of electing special subjects in the course in building construction.

The work of the first two years will be substantially that of the other engineering courses. Students will enter the course from the freshman year and will in the sophomore year pursue the same fundamental subjects, such as mathematics, physics, and drawing, as do the other engineering students. In their junior year they will pursue courses in building design, stresses, structures, materials, economics, and accounting. This will be followed in the senior year by more advanced work in design and by such subjects as mechanical equipment of buildings, specifications and contracts, estimates, business law, and insurance. In this year they will also devote a substantial amount of time to a full year course in building construction in which they will be instructed in the application of the knowledge and principles which they have learned during the earlier years of the course. During the vacations between undergraduate years practical work under supervision will be recommended or required.

The university is prepared to admit students to the first three years of the course. As it will be necessary to secure some men with a wide experience in actual building construction and otherwise competent to give the more specialized work of the senior year, it will probably not be possible to admit students to the senior year at the opening of the university in the fall.

It is the belief of the faculty at Yale that work in building construction will add a very important field to the university's educational program, and they are confident that it will develop into one of their strongest and most useful engineering courses. They also believe that the location of a course of this character in an engineering school closely affiliated with a strong architectural department argues well for the successful development of the course.

Union College Course—The president of the Thompson-Starrett Co., L. J. Horowitz, of New York, has also established a trust fund the income from which is to be used in part to provide training in building construction at Union College. A new four years' course or option in civil engineering has been authorized at Union with a view of affording as broad training in general engineering as possible in four years and at the same time offering therewith specialized work in the design, construction and estimating of buildings. A new professor will be appointed to teach the work in building construction and estimating.

From the graduating class two students are to be chosen each year to enter the Thompson-Starrett organization under the Foundation and remain two years, after which time they become a part of the company's regular force.

At Union the freshman and sophomore years will be exactly the same as now given to civil and electrical engineers—these two courses being identical for the first two years. The junior year will be similar to the regular course in civil engineering except that it will include work in building construction.

The work of the senior year will be as follows:

First Term		*Second Term*	
Mechanical Equipment of Buildings	2	Reinforced Concrete	4
Structural Engineering and Design	6	Structures and Design	4
Business Law	3	Contracts and Specifications	3
Building Construction	3	Building Construction	3
Heat Engineering	3	Heat Engineering	3
Finance and Banking	3	Business Administration	3

The figures in the above table represent the number of exercises per week. Students who satisfactorily complete this course will receive the degree of B.S. in civil engineering.

Proposals in England—"Definite proposals appear to be on the tapis for the foundation in England of a School for Builders to provide for future builders, equal facilities to those enjoyed by intending architects.

"The school would be financed by the Federation of Builders, and would provide the equivalent of a university education with a sort of Master Builder's degree instead of the usual pass or honors degree in law, history, etc.

"The advantages of such a scheme are patent. The organization of a contractor's business is a very com-

plex one and there is no reason why the sons of master builders should not receive a full scientific school training both in theory and the elements of practice. This training would be completed by fuller practical work.

"From the architect's point of view the scheme offers the promise of a better standard of education in the building trade and consequently enhanced understanding between the trade and the profession. Limited collaboration with the big architectural schools would increase the advantages of education on both sides, and would incidentally make possible the conservation of many of the finer traditions of building which are being gradually lost with the spread of commercial building. A revival of the spirit of the craftsman in the operative would not be beyond the range of possibilities, and might counteract the tendency toward mechanical repetition in design. The site for the proposed school is still undetermined, but it is to be hoped that it will not be too far removed from the large architectural schools of the metropolis."

Hydro-Electric Plant with Head of Over One Mile

High-Head, Low-Flow Swiss Plant—Special Steel Penstock 15,200 Ft. Long—Unusual Design of Pelton Wheels

By Fred A. Noetzli
Chief Engineer, Bissell & Sinnicks, San Francisco, Calif.

A HYDRO-ELECTRIC power plant of 12,000 hp., operating under a head of practically one mile (1,650 meters), and having a single penstock of less than 2 ft. diameter, was recently constructed and successfully put in operation in Switzerland. The water utilized in this development is drawn from the little lake of Fully which is located in the westerly part of the Swiss Alps at an altitude of about 7,000 ft. above sea level.

FIG. 2—METHOD OF MOUNTING RUNNER BUCKETS
One bucket is placed on top of the runner to show its construction.

The lake is tapped by a tunnel and pipe line about 100 ft. below normal water level. The penstock extends from the intake at the lake bottom for a distance of approximately three miles down to the valley of the Rhone River. Fig. 1 shows the power house and the penstock location. Lake Fully is located behind the far mountain range through which the penstock pipe is carried in a tunnel.

Storage Increased by Pumping—The natural storage capacity of the lake, which is very small, was increased by the construction of an arched masonry dam 40 ft. high. The useful storage above the intake tunnel is 2,600 acre-ft. Due to the high head this represents a stored energy of 10,000,000 kw.-hr. The power plant is used as a reserve for a low-head plant and is operated intermittently. This makes it possible to increase the quantity of water available from Lake Fully, which has a very small drainage area, by the addition of water pumped from a little lake located 450 ft. below Lake Fully. The penstock passes very near this lower lake, and a centrifugal pump, operated by a 640-hp. electrical motor and discharging directly into the penstock, pumps water from the lower lake through the penstock into the upper lake. The difference in elevation between the two lakes is approximately $\frac{1}{10}$ of the total head of the power plant. Inasmuch as the pumping efficiency averages about 50 per cent, the pumped water produces in the high-head plant six times the energy which is required to pump it to the upper lake.

FIG. 1—GENERAL VIEW OF THE POWER HOUSE AND PENSTOCK

The Penstock—The penstock has a total length of about 15,200 ft. and it is made up of a series of steel pipes of different diameters and thicknesses according to the head of water. The inside diameter of the upper 7,500 ft. is 24 in. (60 cm.) and of the lower 7,700 ft. is 20 in. (50 cm.). The thickness of the pipe is approximately $\frac{1}{4}$ in. at the intake, and increases in steps in proportion to the pressure, to $1\frac{1}{8}$ in. at the lowest point where the static head is 5,400 ft.

The pipes sustaining the greatest head were manufactured by a special process, and all pipes were tested

in the shop for 50 per cent over the given pressure. The whole penstock was put about four feet underground, and no expansion joints were provided. Fig. 3 shows a profile of the penstock location. With the exception of three short tunnels, the trench follows closely the topography of the ground.

The whole penstock is built up of straight pipes 20 ft to 40 ft. in length, according to the permissible weight of each section as limited by the transportation facilities. A special type of joint was used which permitted the making of small angles in the pipe line. Two wedge-shaped rings are inserted between the pipe ends, as illustrated in Fig. 4. By rotating these rings in a suitable manner relatively to each other and to the pipe-ends, any angle up to 10 deg. was obtained, either in a horizontal, vertical or inclined direction. This greatly facilitated the laying of the pipe. The pipes were fastened together by means of special flange rings and bolts, which for the lower portions of the penstock were made of nickel steel.

All joints were tested in the field for 25 per cent over-pressure. The excellence of the workmanship is well illustrated by the fact that the penstock has been in successful operation for several years although, in addition to the waterwheels, a battery of twelve hydraulic presses which cause considerable fluctuation of the pressure in the penstock, is directly connected to the pipe line.

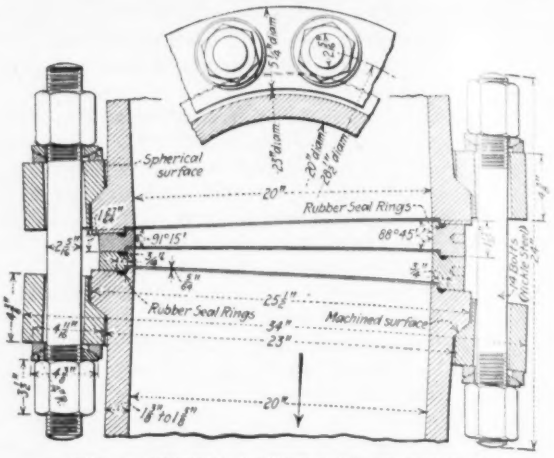


FIG. 4—SPECIAL JOINTS IN THE PENSTOCK

The joints are provided with wedge-shape rings to allow for minor changes in alignment.

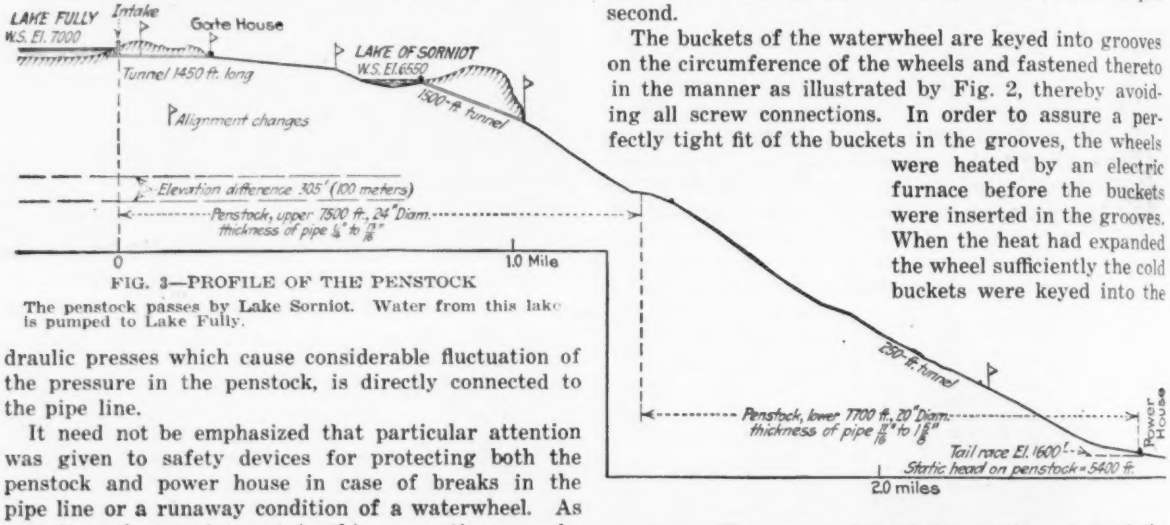


FIG. 3—PROFILE OF THE PENSTOCK

The penstock passes by Lake Sorniot. Water from this lake is pumped to Lake Fully.

It need not be emphasized that particular attention was given to safety devices for protecting both the penstock and power house in case of breaks in the pipe line or a runaway condition of a waterwheel. As a matter of some interest in this connection may be mentioned novel automatic high-pressure needle valves which close at a pre-determined variable speed as soon as a serious disturbance of the water pressure in the penstock occurs. The time required for closing varies from 30 to 60 sec., so that no dangerous water-hammer can occur. When the power plant is operating at full load, the penstock delivers 28 sec.-ft. for the total 12,000 hp., and the velocity of the water in the penstock is about 13 ft. per sec. The loss of head for these conditions was calculated at 530 ft. or practically 10 per cent of the static head. Inasmuch as the power plant is a reserve installation, and will work at full capacity only during short periods of time, a 10 per cent loss of head was deemed permissible.

The Power Plant—The power plant is equipped with four units of 3,000 hp. each, arranged lengthwise with ample clearance to provide a maximum degree of safety in case that, for instance, a bucket should fly off. The waterwheels are of the Pelton type, and their construction and the design of nozzles and valves was unusually difficult owing to the large head under which they operate. Each 3,000-hp. unit is driven by a stream of water of 7 sec.-ft. issuing from a nozzle of 1¾ in. in diameter at the enormous velocity of about 540 ft. per second.

The buckets of the waterwheel are keyed into grooves on the circumference of the wheels and fastened thereto in the manner as illustrated by Fig. 2, thereby avoiding all screw connections. In order to assure a perfectly tight fit of the buckets in the grooves, the wheels were heated by an electric furnace before the buckets were inserted in the grooves. When the heat had expanded the wheel sufficiently the cold buckets were keyed into the grooves. The contraction of the cooling steel of the wheel produced the desired result.

The speed of the waterwheels is held within close limits to avoid undesirable effects upon both the penstock and the machinery. If the load of a unit is thrown off instantaneously, the nozzle is deflected within 2 seconds, and the movement of the needle is timed so as gradually to close the nozzle in 40 seconds.

No unusual features are involved in the design of the generators. Each of the four units has a capacity of 2,800 kva. and generates three-phase current at 10,000 volts, and the power is transmitted at this voltage.

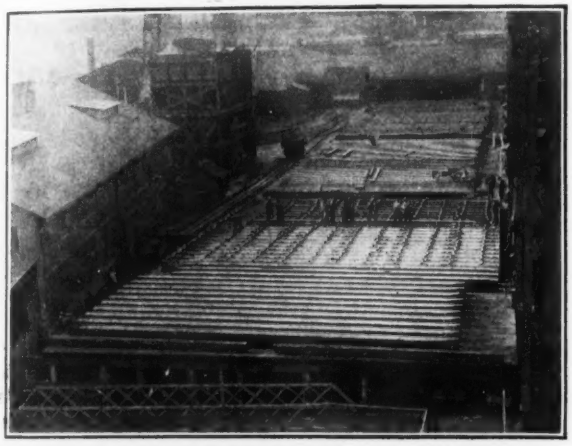
This project was designed and constructed under the direction of A. Boucher, hydraulic engineer, of Lausanne. All machinery was furnished by Swiss manufacturers. The power is used for electro-chemical purposes by the Société d'Electro-Chimie de Martigny, Switzerland. A detailed description of this development, which is the highest-head hydro-electric power plant that was ever built, is given in *Schweizerische Bauzeitung*, Nov. 25 to Dec. 30, 1922.

Quay Wall Reconstruction at Mare Island Navy Yard

Old Wall Embodied in New Structure Which Includes Concrete-Protected Ties Extending Inland 200 Ft.

By A. W. Earl
Supervising Engineer, Public Works Department, Mare Island Navy Yard

Early in 1920 a serious outward movement began on about two-thirds of the entire length of a 3,600-ft. quay wall at the Mare Island Navy Yard in California. During the year this movement amounted to over 3 in. and culminated in the total failure of one stretch 120 ft. long. The wall was being subjected to



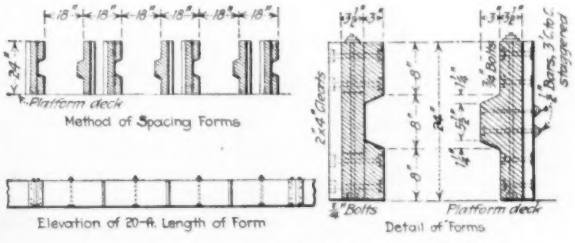
PILE CASTING YARD AND MIXING PLANT
Cantilever traveling crane supports at right. Finished piles in foreground spaced ready for next pour. Concrete mixing plant in left background.

pressure greatly in excess of that for which it was designated, and it was apparent that immediate steps toward reconstruction were necessary to prevent its complete collapse. An effective means of anchoring the reconstructed wall was worked out, using a system of long ties extending from a reinforced-concrete beam along the seawall to deadmen inshore.

The old wall was built in a number of short sections between 1898 and 1904. The type of construction varied somewhat but in general consisted of a concrete or ashlar faced rubble seawall supported on wooden piles. The walls were of the platform type with a timber sheet pile bulkhead in front of the rubble, masonry or concrete face wall. At the time the original wall was built naval vessels were much smaller than those of today and consequently a lesser depth was required alongside the wall than at present. As repeated increases in the draft of ships necessitated deeper dredging the wall was required to withstand a continually increasing pressure which finally resulted in partial failure. However, while the outward movement of the wall was the immediate reason for reconstruction, the work must have been undertaken in any event on account of the very serious damage caused by the teredo.

Previous to the year 1917 the waters of Mare Island Strait had been free from teredo and consequently all waterfront structures were constructed on timber foundations. Beginning in 1917 the teredo made their presence known and during the succeeding years caused extensive damage in Mare Island and Carquinez Straits. Fortunately, with one short exception, quay walls at Mare Island were constructed with a timber bulkhead at the front of the wall which protected the wooden pile supports of the relieving platform. This made it possible to incorporate the old wall in a concrete structure of design suited to present needs. It also facilitated the new construction and made the removal of the old wall unnecessary.

The wall as reconstructed consists of a row of

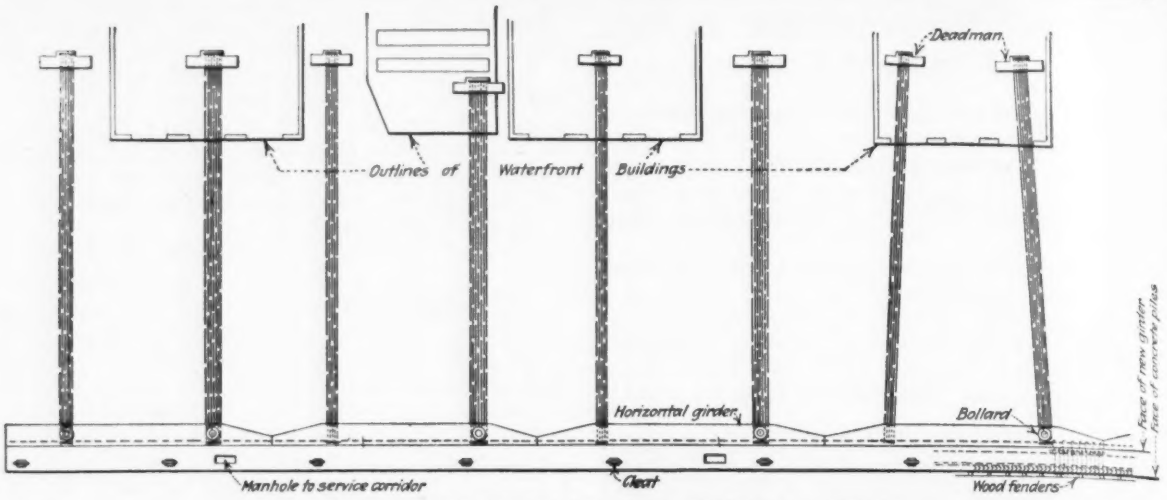


DETAILS AND SPACING OF FORMS IN PILE CASTING YARD

18x24-in. reinforced-concrete sheet piles driven with the inner faces about 6 ft. 6 in. outboard of the face of the old wall. These piles are driven until their tops are 1 ft. below the top of the wall and are tied back by steel rods to a horizontal reinforced-concrete girder which replaces the top portion of the old masonry face wall. This horizontal girder in turn is tied back at intervals varying from 30 to 60 ft. to concrete deadmen which are buried at distances varying from about 100 to 200 ft. back from the wall. The deadmen are buried with their tops 5 ft. below the surface and are 12 to 19 ft. long and 8 ft. deep.

The space between the back of the new concrete sheet piling and timber bulkhead under the old wall is filled with rock up to about 2 ft. above mean low water. The

PILEDRIVER AND PARTIALLY COMPLETED WALL
Note waling strip tied by rods into beam made of two channels which in turn is anchored in large concrete beam. Space between wall and sheet piling is concreted up to form service duct.



PLAN OF TYPICAL PORTION OF NEW CONCRETE SEAWALL

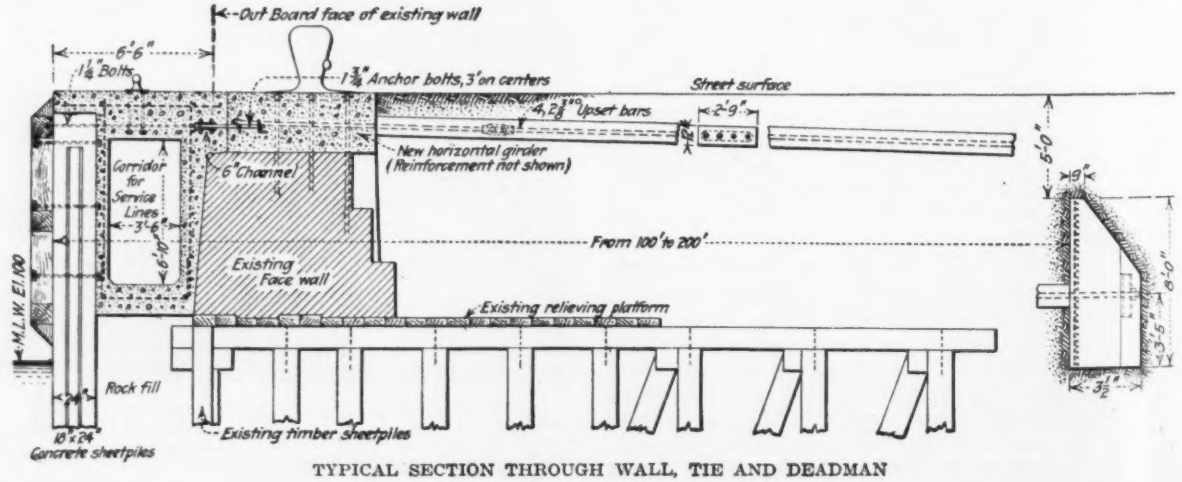
space between the concrete piling and the old face wall is utilized to form a corridor for the accommodation of service lines which, through outlets in the face of the wall, will supply ships berthed alongside with air, steam, electricity, fresh and salt water, and telephone service.

In addition to the 2,300 ft. of quay wall reconstructed on this plan, there remains about 1,300 ft. of wall to which, on account of different construction of the original wall and different conditions at the site, the design described will not apply without modification. Final designs for this remaining portion of the wall have not yet been developed.

Because of the urgent necessity of stopping further outward movement, the reconstruction of the old wall was started in November, 1920, with the limited funds available at that time. When the first 200-ft. section was completed it became necessary to stop work until Congress made a special appropriation for continuing it. This was done July 1, 1922. By July 1, 1923, about 900 ft. of wall had been finished and concrete piles had been cast for about 500 ft. more. The estimated cost for the 3,600 ft. of wall is $1,260,000, or an average of $350 per foot. The portion now under construction runs about $325 per foot.

The work in its entirety will require approximately 2,400 reinforced-concrete sheet piles varying in length from 50 to 60 ft. and consequently it was of the utmost importance to have an adequate casting plant. Fortunately, there was available a small ship-building slip, used during the war for the construction of destroyers, which is served by a traveling, ship-building-type cantilever crane of 15 tons capacity. This slip was adapted to service as a pile casting yard by flooring it with 2-in. plank to make a level platform 65 ft. wide by 400 ft. long. This area is sufficient for laying down 200 piles at one time. About midway of one side of this platform a concrete mixing plant was constructed, with the usual storage and bunker equipment. The bunkers are served by means of a locomotive crane and grab bucket operating on a track. The cantilever crane completely covers the whole area of the platform, and is used in placing forms and reinforcing frames, in transporting concrete from the mixing plant to the forms, and in transporting the finished piles to the barge which berths at the outboard end of the platform.

The forms used, shown in the accompanying illustration, have proved very satisfactory, being durable and easily placed. When first set up they are so spaced that the spacing of piles cast in the first pour is just right to permit the pouring of alternate piles between those already cast, thus conserving space and forms. The platform is constructed with two slots or openings

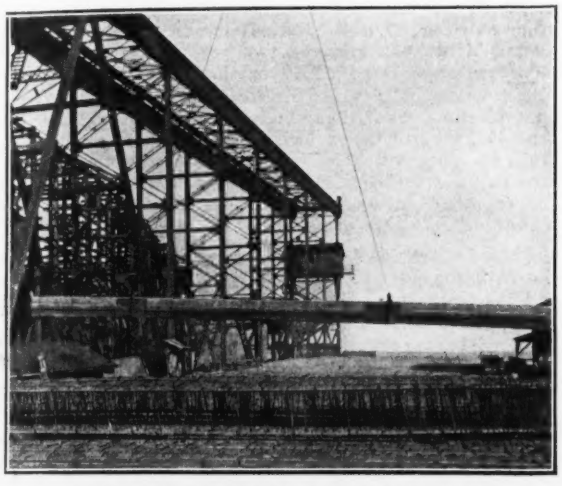


TYPICAL SECTION THROUGH WALL, TIE AND DEADMAN

about 6 in. wide running its full length transverse to the piles and at about the third point. Before the concrete is poured these slots are filled in with short pieces of 1-in. boards, which can later be removed from beneath to allow the use of jacks in separating the piles and to afford a convenient means of passing slings around the piles for lifting them.

It should be stated that the construction of the casting platform could have been improved by laying the plank flooring at right angles to the piles instead of parallel thereto. The unevenness between adjacent planks caused trouble in separating the piles, whereas if the planks had been laid the other way, in separating the piles, the movement would have been lengthwise of the planks instead of across them.

Considerable experimenting was done before a satisfactory coating was found to put on the sides of the concrete piles when casting the alternate piles between



FINISHED PILE BEING MOVED DOWN THE CASTING YARD

Finished piles are delivered direct to barge moored at end of yard or stored in piles near that point awaiting transfer to the barge.

those from which the forms had been removed. It was finally determined that a mixture composed of two parts of axle grease and one part of rosin, melted together and applied hot, gave the most satisfactory results at the least cost.

In general the plant has been very satisfactory. When casting is proceeding opposite the mixing plant the rate of output is 20 piles in 8 hours. At the ends of the platform, because of the longer haul, this rate is decreased to 12 piles per day. The mixing plant has also proved very useful as a central plant from which to transport in trucks concrete for the horizontal girders, deadmen and other parts of the new wall, which are poured in place. The capacity of the plant for this work is somewhat over 200 cu.yd. a day. Exclusive of the fabrication of reinforcement the plant operates with a force of about 12 men.

When sufficiently cured the piles are transported on a barge from the outboard end of the casting platform to the site of the work. They are driven by means of a skid driver, fitted with a No. "0" Vulcan Steam hammer, operating on the face of the old wall. In general the driving has been very hard but little difficulty has been encountered due to breakage.

This work is under the cognizance of the Bureau of Yards and Docks, Rear Admiral L. E. Gregory, C. E. C., U. S. Navy, chief of the bureau. It is being done by yard labor under the immediate supervision of Captain L. M. Cox, the senior officer of the Corps of Civil Engineers of the Navy attached to the station at Mare Island.

Bates Road Tests Do Not Apply to City Streets

By Ivan E. Houk
City Engineer, Dayton, Ohio

WHILE the various articles describing the Bates road experiments have set forth the general conclusions which may be drawn from them, they have not made clear the fact that these conclusions are not necessarily 100 per cent applicable to city pavements. Many of the results can doubtless be applied to city streets. The conclusions regarding strength of brick, asphalt and asphaltic concrete surfaces as compared with the strength of the concrete base and those regarding different thicknesses of brick, different proportions of concrete, and so forth, as set forth in *Engineering News-Record* of Jan. 11, 1923, p. 57, probably hold for city streets as well as for country roads. However, it is doubtful if the conclusions regarding the relative thickness of the pavement in the center and at the edges can be applied to city pavements, except in special instances where some unusual circumstance throws the heavy traffic to the sides of the street.

In the first place city streets are wider than country roads. Then again practically all city streets have curbs at the edges of the roadway and sidewalks back of the curbs, built enough higher than the curbs to cause the water to drain into the gutters at the edges of the pavements, whereas, in the case of country road pavements, the sides of the road are generally lower than the edges of the pavement and slope downward toward drainage ditches at the sides. Therefore the conditions at the edges of a city street are much better as regards strength of foundation than are those at the edges of a country road. The straight curb, which is often used in the case of a concrete roadway, goes down into the ground several inches below the bottom of the pavement, extends several inches above the top and has earth back of it. Certainly this condition tends to hold the subgrade in place at the edges. The combined curb and gutter has the same effect, though probably not to so great a degree. Moreover city streets are generally well sewered. Consequently the subgrade at the edges is much less likely to become water-soaked.

On country roads the traffic generally follows the edges of the pavements, even though there are but few vehicles on the road. In the city the opposite situation prevails. There the traffic generally keeps near the center of the roadway, even though there may be nothing to prevent its following the edges. There are several reasons for this: (1) The parking of cars along the curbs requires the traffic to keep away from the edges; (2) Trees just back of the curbs often partially obstruct or cloud the view along the edges; (3) There seems to be an inherent tendency in the most of us to keep away from the gutter on the steeper portion of the crown whether we are driving slow or fast, whether cars are parked at the sides or not.

Improved Location and Equipment of Passing Tracks

Space Sidings by Time Rather than Distance and Operate Switches from Tower to Avoid Train Delays at Small Cost

THE LOCATION of passing sidings and the mechanical operation of their switches to avoid delays to trains are important factors to be considered by the engineer in connection with the effective or economic handling of traffic on busy single-track lines. This subject was included in a copyright paper on methods of increasing the traffic capacity of single-track railroads, read at the annual meeting of the American Association of Railroad Superintendents by Bertram H. Mann, signal engineer of the Missouri Pacific Ry. The purpose of his study was to show that operation of a freight-train district is a mathematical problem and that the proper balance of a budget for physical improvements to the road may have a close relation to this problem. His plan is based on careful analysis of train movements in relation to the positions of telegraph offices and passing sidings. The paper deals largely with operating conditions, but the portions which are of more direct interest to the engineer are summarized below.

In the first place, telegraph offices at sidings should be systematically spaced and these sidings should not be located arbitrarily at stations. Each run between telegraph offices should have at least one intermediate siding to provide for heavy traffic. In the second place, the spacing of sidings must be fairly uniform, with due allowance for grades and other conditions, in order to insure a steady movement of traffic. If the train periods between sidings vary considerably, the stream of traffic will be governed largely by the movements on the longest run. To handle traffic effectively on a single-track line whose business seems to call for double-tracking: (1) Trains must be forwarded from the starting point at such intervals as are determined by experience with average performance, and (2) the predetermined time periods between sidings must be maintained.

On a freight-train district the saving in operating expense which may be made by correct location of sidings and providing them with continuous-service telegraph offices is too great to permit of arranging them arbitrarily to coincide with traffic requirements by enabling the operators to sell tickets or handle freight at stations. On a single-track district of moderate traffic density the accounting item of "cost of freight-train train-miles" may amount to $50,000 or even $75,000 per month, divided equally between locomotive repairs, wages and fuel. A freight train run of 145 miles made in an average time of 12 hr. 5 min. costs $201.19 for these three items, representing 28.7c. per minute or $17.21 per hour.

In the art of handling a single-track railroad freight subdivision, any consideration of distance in locating the sidings is far from the point. The main question is the time spacing. Profile of grades is one factor in fixing the number of minutes for this time spacing between sidings, and another is the time required for service or work at the station. Traffic movement on single track must be in waves, and the best condition exists when the waves marked by adjacent sidings are equal and the continuity of flow is least broken at the sidings. The waves are made up of three parts: (1) running time between sidings, (2) time required to "head in" and "head out" at the sidings, and (3) time required at the siding. It has been held by many officers that a spacing of four to five miles for lap sidings on single track was sufficient for full capacity owing to the delays involved by heading in and heading out of the siding. But such delays should not govern traffic movements or siding location.

Delays incident to taking sidings may be reduced materially by having the telegraph operators handle the switches mechanically. From the financial viewpoint a railroad can hardly afford the expense resulting from delays on districts operated by heavy engines and long trains, when these trains have to be stopped while their crews operate the switches. With a rule for one-direction traffic and all trains headed in at the lapped end of the sidings, it requires only small expense to install a simple mechanical interlocking plant with levers in the telegraph office. At the farther end of the siding, a remote-control low-voltage installation handled from the telegraph office, or a spring switch with automatic electric signals, will save a stop for the train when heading out to the main track. Such helps are in successful use.

Ordinary freight trains standing on sidetracks for more than 20 per cent of the time of the entire trip are subjects for investigation, but in many cases this period is from 30 to 40 per cent. For an average speed of 12½ m.p.h. from starting point to destination, an average speed of 20 m.p.h. between stops is required, and the aim should be an average speed of 20 m.p.h. between sidings, with idle time on sidings not exceeding 20 per cent of total time of run. The Adamson law has one good feature in that it has shown convincingly the gain of the moving train as opposed to the loss by unproductive time. Punitive pay for overtime of train crews stimulates a search for causes of delay when the desired speed cannot be maintained.

Four factors in the operating output of ton-miles are the ruling grade, the drawbar pull, the weight of train and the train speed. Further, every freight-train district has a characteristic movement or period. For development of traffic capacity this period must be determined, the train movement arranged in consonance with it and the spacing of sidings and telegraph stations made to synchronize with it.

Study of the problem of improving freight-train service develops certain laws of single-track operation and proves the money value of the mathematical operation of trains. Such a study prompts the use of special devices on the locomotive (booster, superheater, feed-water heater, thermic syphon and arch), of signal and interlocking plants, and, last but not least, of a uniform scheme for the operation and arrangement of sidings and siding facilities. The length of subdivision is fixed, so that the only variable factors are tonnage and time. For a meeting on single track under present train rules, the switch at which the inferior train takes siding becomes a "bumping post" or stopping point for the opposing train. With the recommended plan, it is feasible for both trains to drift the entire length of each siding at the meeting point. The next step is the extension of individual sidings as traffic demands, with a view to the ultimate double track.

In considering a budget for improvements there may be seven or eight freight-train districts or subdivisions which are not satisfactory as to performance. It is not unusual to select the worst subdivision and provide large outlays for double-tracking or grade reduction which builds up its capacity beyond its immediate traffic requirements, while nothing is done to the other subdivisions which equally require relief. The plan outlined above contemplates the study of each subdivision, with such rearrangement of siding, spacing and handling as will fairly meet the existing demands. The layout would permit growth as traffic increases until double track is reached eventually. Such a program will supply the needs of several subdivisions at a cost perhaps less than the single comprehensive overhauling of one selected subdivision. Waste of time by idle trains may be overcome in many cases by slight rearrangement of or addition to existing facilities.

Local Laboratory Control of Water Supplies in California

SUCCESSFUL chlorination depends on a certain amount of laboratory control under the immediate direction of the operator or water superintendent. Holding this viewpoint the California State Board of Health has recently undertaken to establish local laboratories wherever chlorination or any other treatment of the water supplies of the state is practiced. Once before the board tried to interest the officials of the various cities in laboratory control but the tests proposed were too elaborate and the work was gradually abandoned. Recently the procedure has been reduced to the simplest terms possible, viz., the bacterial count on agar before and after treatment.

C. G. Gillespie, director of the bureau of sanitary engineering, states that the making of the tests accomplishes three things: (1) It gives the people responsible for the supply a record of results achieved which, in case of litigation and damage suits, is most valuable. (2) It apprises the consumer and officials every day as to just how successfully the supply is being safeguarded. (3) It stimulates the interest of the man in charge more than anything else he can do, because it gives him visible evidence and a yard stick by which to measure the results of his carefulness.

EQUIPMENT FOR BACTERIAL COUNTS

Quantity	Description	Size	Price
1	Incubator, electric	12x12x12 in.	$20.00
1	Oven, drying, electric, three heats, state voltage	18x14x14 in.	42.00
1	Hot plate, circular, 3 heats	6 in. in diam.	9.25
24	Pipettes, graduated without bulb, 1 c.c. capacity for bacterial work	.....	3.32
1	Pipette box, copper	10 in. in length	2.00
24	Bottles, water sample, ground stopper	4 oz.	5.70
24	Petri dishes	100x10 m.m.	7.20
1	Beaker, copper, with lip, capacity 500 c.c.	.....	1.50
2	Beakers, pyrex, with lip, capacity 250 c.c.	.....	0.54
1	Thermometer (ordinary bath thermometer, armored in wood)	.....	0.75
1	Reading glass	3½ in. in diam.	2.00
3	Grease pencils, red or black	.....	0.45
6	Brushes, test tube	¼ x 9 in.	0.40
12	Counting plates for petri dishes, cardboard	.....	1.80
72	Tubes, culture	¼ x 6 in.	1.38
½ lb.	Dehydrated 1 per cent agar	.....	2.00
1	Pressure cooker, with ground cover joint, vent, safety valve and pressure gage, basket and support	12 qt.	30.00
1	Aluminum kettle and spoon, 6 in. in diam.	2 qt.	2.00
1	Set standard measuring spoons	.....	0.15
1	Pint measure or standard measuring cup	.....	0.25
1 lb.	Absorbent cotton	.....	0.60
1 gal.	Distilled water	.....	0.25
6	Dish towels	.....	0.75

Operators of average intelligence have been taught without difficulty to make the tests and obtain reliable results. Mr. Gillespie states that in his opinion establishment of these local laboratories is one of the longest steps forward in putting chlorination on a more dependable basis.

W. F. Langelier, chemist, and bacteriologist for the board, has tabulated the following list of materials for equipping a "minimum" laboratory and given certain instructions, but he recommends that the operator visit Berkeley, or a laboratory already installed. Simple instructions are given for making media, sterilizing glassware, plating, incubation, counting and keeping records.

Low Sewage Sludge Freight Rates in England

Dried sewage sludge, bagged, will be carried at special rates by the railways of England hereafter, says the London *Surveyor*.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Dr. Waddell Asks Help for Japanese Engineers

Sir—Owing to the awful calamity that has just occurred in Japan, many of our brother engineers in that country must be in dire need, and will be for some time to come—as will be also the families of those engineers who have perished. It has struck me that it would be a kind and friendly act for the engineers of America to contribute individually *but as engineers* through the New York City Branch of the Yokohama Specie Bank, one-half of the money thus sent being used immediately for general relief of the suffering populace, and the other half later for engineers and their families. I have arranged with the manager of the bank to receive and distribute in that manner all moneys thus sent, working later through the Civil Engineering Society of Japan. Please make checks payable to Engineers' Relief Fund of Yokohama Specie Bank, the address being 120 Broadway, New York City.

For years it has been an earnest desire of mine to see the peoples of Japan and America brought permanently into harmony and close friendship, and if we Americans now help the Japanese generously in their hour of need, they will never forget it; because, from long personal experience, I know them to be a truly grateful and appreciative people.

I trust that each American engineer will contribute as liberally as he can, but even small amounts would help—on the principle that "mony a little maks a muckle."

New York City, Sept. 4, 1923. J. A. L. WADDELL, Consulting Engineer.

[While we sympathize with Dr. Waddell's desire to render every aid to the Japanese sufferers we are inclined to doubt the desirability of separating the various aid funds by professions or other divisions. It seems to us that a much better way would be for everyone to contribute within his means to the American Red Cross.—EDITOR.]

Engineers in the Public Service

Sir—I take pleasure in reading your editorial comment in the current issue on the explanation offered by the Secretary of the Interior relative to the reorganization of the U. S. Reclamation service.

Leaving aside personalities, it is well known how often engineers are supplanted in this country by so-called business men as soon as the major construction problems have been solved. It cannot be contended that all engineers are necessarily good business men but there are abundant examples where engineers have succeeded in the business sense because of spcial fitness for administration and operation of engineering works.

In the public service every citizen has a right and duty to demand that the best possible service shall be given. It is certainly reasonable that heads of departments having vast engineering enterprises in charge should themselves be engineers of the highest qualifications. It is deplorable that politicians or so-called business men should get control and subordinate or dominate at will those who do possess the ability to manage these nation's enterprises. Each time it occurs, vigorous opposition should be given. Let engineering work be done by engineers and let them have the honor—yes, and the pay, too.

Newport News, Va. August 25, 1923. GEORGE C. LOVE, Consulting Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The Contract Has Been Let for the First 25 miles of the new railway being built by the Ontario Government from Swastika to Larder Lake in the gold mining region of Northern Ontario. It is expected that it will be completed as far as Kirkland Lake this fall.

The British Columbia Government is continuing work on its reclamation project near Sumas. Thirty thousand acres of land that lie along the Fraser River are being protected from the river by concrete dikes and water from this low land is to be pumped up into the river by four electric pumps of a capacity of 1,250 hp. each.

Arrangements Have Been Effected by the Montreal and Quebec interests for the organization of the Laurentide Hydro-Electric Power Co. Ltd. Power rights have been acquired on the North River near St. Adele and the company will be in position to serve the industrial centers of St. Agathe, Piedmont, St. Margaret, Strawbridge and St. Adele.

Contracts for Two Extensions to northern Alberta railways, viz.: thirteen miles west of Berwyn, north of Peach River, Alberta, and fifteen miles to Lake Saskatoon, west of Grand Prairie, on the Canada Central Ry., have been let by the government to James Mohler, Sr., of Ohaton, and construction will be commenced shortly, though it is not thought probable that the work will be completed in time to be of service in handling this year's crop.

Plans Are Being Prepared for a dam 400 ft. long across the North branch of the Ottawa River near Bryson, Quebec, and for a transmission line about 50 miles long to Ottawa, Ontario. This plant is being built by the Ottawa River Power Co., a subsidiary of the Ottawa and Hull Power Co., Ltd., and will add 9,000 hp. to the 31,000-hp. capacity of the two plants of this company on the Ottawa River near Ottawa. In addition, the company controls at Bryson, Quebec, another power site capable of developing 60,000 hp.

D. C. Coleman, Vice-President of the Canadian Pacific Ry., Western lines, states that the branch line program carried out this year will bring into operation on the prairies a larger mileage than any year since 1914. Of the 431 miles of line under construction 281 miles will be ready for grain handling in the fall if sufficient labor is available. Branch lines complete and ready for grain handling are the Consul Easterly 60 miles; Rusetown 45 miles; and Naicam to Melfort 32 miles. Most of the lines constructed or under construction tap territories hitherto without railway service or too far from lines to make extensive farming profitable on account of the long haul.

Miners Strike as Pinchot's Plan Fails

Strike of about 155,000 anthracite miners in the Pennsylvania fields began last Saturday, when representatives of the United Mine Workers of America and the operators were unable to agree on the terms of the compromise plan of Governor Pinchot.

Governor Pinchot's plan included: recognition of the basic eight-hour law for all employees; a uniform increase in pay of 10 per cent; full recognition of the union by the operators, without the check-off, but with the right to have a union representative present when the men were paid; and complete recognition of the principle of collective bargaining.

Though the miners have gone out, apparently doors are not closed to the Pinchot plan, as conferences between contesting parties are being carried on, without, however, any suggestions so far from the U. S. Coal Commission, which body has kept entirely out of the negotiations since the unsuccessful attempt it made two weeks ago to avert the strike by calling the New York City conference.

Economy to Be the Policy of the New York Public Works Dept.

Special Correspondence

The policy of the re-organized Public Works Department of the State of New York is to be one of economy according to the new superintendent, Col. Greene. He is reported to have said that "the idea of this consolidation is not more jobs, but fewer jobs just as soon as I can find a way to do it."

Among the early economies hoped to be effected is the housing under one roof of the canal and highway divisions and the consolidation of the two bridge and grade crossing elimination divisions now in the department of highways. Under the new law the superintendent has the right to abolish any position or to consolidate it with another and all of the appropriations made for the various departments are lumped. Consequently the personal patronage at the disposal of Col. Greene is enormous, totaling in excess of $4,370,000. In the highway division, outside of the $240,000 for the Albany office, there was appropriated this year for engineering supervision, inspectors, laborers, mechanics, chauffeurs and trucks on the nine highway divisions of the state $2,290,000; the division of public works has at its disposal $1,540,000 for personal service while the division of public buildings has $300,000.

Amongst political leaders the appointment of Col. Greene is not entirely a popular one because of his known desire for economy and its possible effect on the barge canal situation.

The waterways advocates have been most active in circulating stories that the opposition, convinced that the canal is a failure, has advised the Governor to abandon the canal for navigation purposes and use its flow for the production of hydro-electric energy.

Colonel Greene Heads New York Public Works Department

Frederick Stuart Greene, commissioner of highways, has been named superintendent of Public Works of the State of New York under the reorganization bill which went into effect July 1, 1923. The appointment, which expires with that of the Governor, must be confirmed by the Senate when it convenes in January next. The reorganized department of public works, as outlined in *Engineering News-Record* May 17, p. 895, and June 7, p. 1015, includes the commission of boundary waters, the department of highways, the interstate bridge commission, and the department of public buildings.

Edward S. Walsh, superintendent of public works before the reorganization became law, has been appointed commissioner of canals and waterways; Lowell Grossman has been appointed to head the highway division, and John J. McNulty has been reappointed as head of the department of public buildings.

Colonel Greene has been engaged in engineering work since 1893. He is a graduate civil engineer of Virginia Military Institute and a member of the Am. Soc. C. E. Previous to 1917 he was engaged in highway, tunnel, subway and foundation work, chiefly in New York State. He served through the war as a battalion commander with a combat engineer regiment of the 77th Division. In April 1919 he was appointed commissioner of highways by Gov. Smith, which position he held until asked to resign by Gov. Miller in 1921, but was reappointed this year by Gov. Smith. In the interim he was in highway work, both in Panama and in Pennsylvania.

Edward S. Walsh has been prominent in canal transportation for years. He was deputy superintendent of public works in 1919 and later superintendent, and was reappointed by Gov. Smith in 1923.

Lowell Grossman has been in the state highway and engineering department since 1906, having worked his way up from rodman to assistant to the first deputy. During the war he served as a captain with the 23rd Engineers.

Reappointment Confirms Positions of California Officials

In accordance with an opinion recently rendered by the attorney-general of California, the act passed by the last legislature divorcing the state department of public works from the state highway commission, made it necessary for the Governor to reappoint the heads of both these departments. This was done on Aug. 27, the appointment confirming the positions held by W. F. McClure, state engineer and director of the reorganized department of public works, Robert M. Morton, highway engineer and Harvey M. Toy, Louis Everding and Nelson T. Edwards as members of the state highway commission.

$1,000,000 So Far Raised for Sesqui-Centennial

Exposition Building Program Includes Expenditure of $15,000,000—Engineers Are Active

Definite progress has been made in the development of the organization and of detailed plans for the sesqui-centennial exposition in Philadelphia in 1926 by the Sesqui-Centennial Exhibition Association, the organization of which was noted in *Engineering News-Record* March 30, 1922, p. 543. To date a million dollars has been subscribed to the Association by individuals and corporations, and plans are complete for a campaign to raise five million dollars by sale of bonds to the public. Five million dollars has been pledged by the city of Philadelphia. Five million more will be secured from other sources, making a total of fifteen million dollars, which is the estimated cost of building the exposition.

The site for the exposition begins on the Parkway at Logan Square, and extends through Fairmont Park to include the buildings and grounds on the west side of the river used for the Centennial Exposition. Schuylkill River flows down the middle, and at either side are rolling banks topped by broad plateaus. The trees and shrubbery are of mature age, and so set as to be usable for decorative purposes. The grounds as now outlined include 515 acres, and the buildings already projected contain 60 acres, and are arranged to permit of such further extension as may be required.

CONSTRUCTION PROGRAM

It is proposed that construction on a large scale shall begin in the Spring of 1924, giving a year to prepare the grounds and get the buildings ready for the installation of exhibits, and another year for the completion of the project. The gates will open on April 30, and will close on Nov. 13, 1926.

Engineering problems involved in the development of the site are simplified by the inclusion within the area of a number of permanent buildings, and by the fact that the area is now developed park land with roads and paths and supplied with sewage and water facilities. Permanent buildings on the site include the Philadelphia Art Museum and the Philadelphia Free Library, both of which are now under construction, and the Pennsylvania Museum and Horticultural Hall, which were built for the Centennial Exposition. The United States Government and the Commonwealth of Pennsylvania will be asked to construct permanent buildings to house their exhibits. Victory Hall, a convention hall planned as a memorial to the Philadelphians killed in the World War, is within the site and will be completed when the Exposition opens. The women of Pennsylvania are planning to construct a large permanent hospital. Some of the other buildings will be of temporary nature, to be removed when the Exposition closes, but many of the buildings will be of semi-permanent nature, to last for fifty years or more.

In the organization to carry on the work of the Sesqui-Centennial, engineers have from the start played leading roles. The executive director of the association is Col. John Price Jackson. Directors and department chiefs are now being selected tentatively, and will be appointed after the public sale of bonds is complete. The grounds and buildings committee, one of the most important committees, has a total membership of 54, of whom 19 are engineers.

Brazilian Railway to Electrify 35 Additional Miles

Contract for upward of $1,000,000 worth of electrical equipment has been awarded to the International General Electric Co. by the Paulista Ry. of Brazil for the electrification of 35 additional miles of its railway. This contract is in addition to the one awarded to the General Electric Co. in 1920 for 28 miles of double track electrification, and brings the total electrified mileage up to 63 miles, starting at Jundiahy and extending north to Tatu. This is approximately half the total mileage which the Paulista Ry. intends to electrify. The new order includes five 62-ton, 3,000-volt, d.c. switching locomotives, a complete substation of 4,500-kw., and auxiliary equipment for the overhead line and the transmission line.

New Secretary, A. P. H. A., Is Sanitary Engineer

Homer N. Calver, since July 1 acting secretary of the American Public Health Association, was graduated in sanitary engineering from the Massachusetts Institute of Technology and afterwards became assistant health officer of Winston-Salem, N. C. During the war he served in France as an ambulance driver and then in the sanitary corps, attaining a captaincy and the command of a mobile field laboratory. After the war he was for a time acting director of the health service, American Red Cross, and recently he has been engaged in a survey of child health agencies in New York City, under the Public Health Committee of the New York Academy of Medicine.

Large Power Development Planned for Alaska

In connection with the announcement that the government has made a conditional sale of 334,000,000 ft. of timber in the Cascade Creek unit on Thomas Bay in the Tongass National Forest of Alaska to the firm of Hutton, McNear & Dougherty of San Francisco, it was announced that the purchaser has agreed as part of the consideration to build a pulp manufacturing plant of not less than 100 tons daily and of an ultimate capacity of 200 tons at the Cascade Creek water power site on Thomas Bay 20 miles from Petersburg, Alaska. The estimated capacity of this site is 23,700 hp.

Licenses to develop the water power in the National Forest of Alaska are obtained from the Federal Power Commission under an arrangement which allocates the power sites to the manufacturers of the timber most logically available to them. The Forest Service and the Federal Power Commission are collaborating in a survey of the more important water powers in southeastern Alaska which will ultimately be developed in establishing the paper industry.

Engineering Editors Broadcast from New York

All during this summer various editors of the McGraw-Hill Co., Inc., have been broadcasting short talks on engineering information from station WJC in New York City. This will continue through the fall and the program as at present arranged is for Wednesday, from 8:15 to 8:30 p.m. The schedule so far determined is as follows:

September 5, Earl E. Whitehorne, commercial editor, *Electrical World:* "Who Has More Slaves than Pharaoh—A Talk on Electricity."

September 12, Kenneth H. Condit, editor, *American Machinist:* "Automatic Machines and Their Effect on Men."

September 19, H. C. Parmelee, editor, *Chemical & Metallurgical Engineering:* "The Work of the Chemical Engineer."

September 26, E. J. Mehren, editor, *Engineering News-Record:* "What Engineering Is and What It 's Not."

Skill and Responsibility Required in Concrete Sea Wall Bidders

Skill and responsibility of bidder was announced as being of first consideration in the awarding of the contract for the construction of a concrete sea wall at Vicksburg, Miss. This attitude was taken in view of the fact that the work was of a special nature and needed to be handled with skill and dispatch in order that it will be finished by the next season of high water, and a statement to this effect was included in the "information for bidders." Each bidder was required to fill out a questionnaire giving the following information and attach it to his bid:

Length of time in the contracting business and in responsible charge of work, educational qualifications and training, outline of work similar to that under consideration, training and experience of the proposed superintendent in charge of the work, whether any part of the work is to be sublet, etc.

To discover the integrity of the bidders the following were among the points to be determined: Names and addresses of responsible references, information as to whether any work had been taken away from bidders because of dissatisfaction of owner or engineer, controversies with subcontractors, information as to whether any bidders had been involved in lawsuits.

As a result of the questionnaire only the most reputable contractors submitted bids, according to the Miller-Butterworth Co., of Little Rock, Ark., who had charge of engineering. These bids follow:

Mills Engineering Co., Tupelo, Miss., $322,417.50; Doullutt-Williams, New Orleans, La., $307,133.35; Delta Cement & Tile Co., Greenville, Miss., $349,822; Jefferson Construction Co., New Orleans, La., $259,402.40; List & Weatherly Const. Co., Kansas City, Mo., $274,850.07; Case & Cothran, Atlanta, Ga., $326,102.75.

The questionnaire stated that the information required would be treated in strict confidence, that it would be returned immediately after it had served its purpose and no copy kept, and that questionnaires submitted by contractors whose work along similar lines was well known to the chief engineer would be returned unopened.

Random Lines

Why Contractors Are So Wild

In the Hermitage, Mo., *Index*, the following proposal advertisement recently appeared. Unfortunately there is not time for contractors all over the country to get in bids:

Notice is hereby given that separate bids will be received by the undersigned acting County Highway Engineer until 12 o'clock noon, MONDAY, SEPTEMBER 3rd 1923, for the following project at the Halbert Bridge across Pomme de Terre on Pittsburg-Elkton Public road as follows:

The erection of five concrete piers upon which to place approaches of said bridge described as follows; Length at top of pier 14 feet and 6 inches; Top thickness 18 inches; Bottom of pier 3 feet under surface same size at surface which shall be two inches longer than at top for every foot in height. Thickness at base and at top of ground 36 inches; to be so placed that center of pier nearest bridge shall be 16 feet from center of heavy steel beam connecting and resting upon Iron tube piers at end of bridge. The next pier to be 16 feet from first in same manner, and so on. The height of the piers shall be to a line drawn from top of said heavy iron beam at top and end of bridge to top of concrete pier at end of dirt fill at each end of bridge. Two of said piers to be placed on one side of river and three on other side to fill space. These piers to be paid for by the cubic yard, the person building same shall furnish his own material including concrete and forms. Concrete to be made of one part cement to six parts of clean gravel which shall be approximately one fourth sand. Also this work will include the furnishing and placing of one bolt 8 inches long and size to fit each hole in I beams and channels for support of floor. Said to be so placed that the holes in beams will fit same. Concrete to be well reinforced with barbed wire which the builder will also furnish.

* * *

Even in France

An American engineer resident in France sends an advertisement of the Temple Tours which reads "Our travel engineers are at your service . . . Telephone or call for particulars of delightful tours."

* * *

Last week it was reported in the newspapers that a road laborer in Maryland had dug up a box with $10,000 (some said $100,000) in gold coin in it. Since then the laborer has claimed that it was all a hoax. We thought there was something fishy about the first report. It was the first time we ever heard of anyone admitting there was money in road building.

* * *

Life is getting so complex. Now there's a "new industrial science"—fence building. One of the advertised functions of a fence company "*includes the services of highly specialized fence experts, using blue prints, contour maps and mathematical formulae unknown to laymen.*"

125,000-Hp. Hydro-Electric Plant Proposed for West Virginia

Washington Correspondence

In reply to the protest of the Norfolk & Western R.R., the Chesapeake & Ohio R.R., and the Appalachian Power Co., against approving the application of the West Virginia Power Co., for a license to develop power on the New River below Anderson Falls, the Federal Power Commission states that its engineering staff proposes recommending the approval of the application. The proposed development would drown out the proposed plant of the Appalachian Power Co. at Anderson Falls and its steam plant at Glen Lyn.

The commission's engineers maintain that the West Virginia Power Co.'s project is more comprehensive than the one at Anderson Falls and is preferable to it, and that the question of damage from backwater is a routine one. The proposed development of the West Virginia Power Co. will produce 125,000 hp.

Hearing on Colorado River Project Set for Sept. 24

Washington Correspondence

A hearing which may be expected to bring out fully the conflicting views regarding power and irrigation rights along the Colorado River and which probably will have an important bearing on the pending compact among the states interested will be held Sept. 24 before the Federal Power Commission in Washington.

J. B. Girand, who holds a preliminary permit for development of a hydro-electric project on Diamond Creek, Arizona, recently wrote the Commission asking that action be taken on his application for a license which has been pending since March, 1922, or that he be permitted to present arguments in behalf of the application. A few days later, the governor of Arizona wrote the Commission requesting a conference between that body and a committee of Arizona citizens on the Girand application and the Colorado river problem in general.

In view of these requests, the Commission has notified Mr. Girand to appear before the Commission Sept. 24, and the governor of Arizona has been notified that a committee of citizens or officials from his state will be received on the same date. In order that all interests may be represented, the Commission has invited the governors of Colorado, Wyoming, Utah, New Mexico, Nevada and California to send representatives to this hearing.

The proposed convention for use of the Colorado River waters has been ratified by all the states excepting Arizona and has been advocated earnestly by Secretary of Commerce Hoover as a means of obtaining maximum development in that valley.

An interesting angle of the situation is that the Arizona State permit held by Mr. Girand, which was granted as the last act of Water Commissioner Norviel, will expire Dec. 31 by default if work is not started under its terms, and it is generally believed that, owing to a change in state administration, he would experience considerable difficulty in securing a renewal. But he cannot proceed under the state permit without a license from the Federal Power Commission, which has withheld action on his application for a year and a half.

Commission Changes Bidding Basis for Delaware Bridge Cables

Readvertisement of the contract for the cables of the Delaware River Bridge upon the basis of reduced quantities of work, was directed by the Delaware River Bridge Joint Commission at a special meeting on Wednesday, August 29. Bids had been received for the cables on August 15, but were rejected because the low bid was in excess of the funds available for the purpose. The changes in the amount of work are intended to bring it within the available limits.

The changes made in the work involve the elimination of all castings for attachment of suspenders to the cables, and elimination of the hand ropes, together with a reduction in the quantities of other items except the cable wire itself. Suspender rope is to be furnished in sufficient quantity for construction of the erection foot bridges, but the rope is not to be cut to length.

Suspenders, sockets, and suspender castings will be furnished and erected later under another contract. The estimated quantities of work on the new basis are as follows:

Item 1	Wire Cables	13,500,000 lb.
Item 2	Suspender Rope	50,000 ft.
Item 3	Castings	180,000 lb.
Item 4	High Tensile Bolts	6,000 lb.
Item 5	Structural Steel Shims	30,000 lb.
Item 6	Cast Iron Separators	30,000 lb.

Bids for the work are to be opened on September 19.

Geological Survey Begins Texas Topographic Study

Washington Correspondence

Engineers of the United States Geological Survey began work September 1 on a topographic survey of sections of Texas in co-operation with the State Water Board. Before the end of the month, Glenn S. Smith, chief engineer of the topographic division, expects to have 50 engineers working on the survey.

The work is in connection with the plans of Texas to control the flood waters of the streams of that state which have done millions of dollars of damage in the last few years. The plan contemplates creation of reservoirs to store surplus water and linked with this are plans for irrigation, reclamation and power projects.

The work will require two years. For the first year, the Geological Survey has made plans to spend nearly $100,000 and hopes to be able to make a similar allotment in the second year in order that the work may not be delayed. This amount will be matched by the state, which has appropriated to various funds $600,000 for topographic work. Charles E. Cooke, who is engineer in charge for the Geological Survey in the Texas work, has been in the state making arrangements several weeks.

More states have asked to participate in the federal co-operative topographic surveys this year than ever before. Some work will be done in 27 different states. The federal appropriation available for field topographic work under the co-operative plan this year is approximately $400,000.

Civil Service Examinations

UNITED STATES

For the U. S. Civil Service examinations listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Superintendent of Construction — Vacancies in the Central Office of the Veterans' Bureau, Washington, D. C., for field work on building projects of the Bureau, salary $3,000 to $3,600 per year, rating to be by sworn statement of applicant and corroborative evidence. Application must be filed by or before September 25.

Computer—Vacancies in the Coast and Geodetic Survey for duty in Washington, D. C., at an entrance salary of $1,400 a year plus increase of $20 a month; for duty in the Manila, P. I., office at entrance salary of $2,000 a year plus $20 a month increase; and for duty in computing the triangulation of the Hawaiian Islands, at entrance salary of $1,860 a year. Examination will be held throughout the country on October 4 and 5.

Information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or from the secretary of any local examining board.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga.; Nov. 12 to 16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

Society of Terminal Engineers, New York City, will have as its speaker at a meeting Sept. 11 F. W. Hersey, director of commerce of Wilmington, Del. The meeting will be held in the Engineering Societies Building at 8 p.m.

The Western Society of Engineers' opening fall meeting will be held Sept. 10, when E. Marshall, electrical engineer, Great Northern R.R., will speak on "Railroad Electrification." Other subjects for September are as follows: M. M. Leighton, chief, Illinois State Geological Survey, Sept. 17 on "Influence of Geology on Engineering" and W. A. Gildack, superintendent, W. K. Lithrall Co., on the "Gravel-Washing Plant at Forreston, Ill.," one of the largest in the world.

Personal Notes

H. A. THACKREY has opened an office for general engineering practice in Camden, Ark. Mr. Thackrey is a civil engineer graduate of Kansas State Agricultural College, year 1914.

H. L. OGLE has been made junior partner of the M. Miller Co., contractors and engineers, New York City. Mr. Ogle was formerly district sales manager for the Youngstown Pressed Steel Co., Warren, Ohio.

MAURICE AYRER, Fort Myers, Florida, has been made assistant engineer with A. L. White, civil engineer, Fort Myers, in general engineering practice and in drainage work.

JAMES R. NEVIN, formerly foreman with Harness Bros., general contractors, Ottumwa, Iowa, has been appointed a junior highway engineer in the service of the Illinois State Highway Commission.

LOUIS PARENT, city architect of Montreal, has resigned from the service of the department of public works of the city. Mr. Parent is the architect who designed the new city hall of Montreal, now under construction.

H. F. FLAGG, chief engineer of the State Board of Public Works at Olympia, Wash., has been selected by appraisal engineers of the city of Yakima and the Pacific Power & Light Co. to arbitrate reports of other engineers in fixing the valuation of the Pacific Power & Light Co.'s water system which the city is contemplating purchasing. The three engineers on the board have already begun their sessions in Olympia.

HERBERT HOOVER was elected to honorary membership in the Czechoslovak Engineers and Architects Association, at the annual conference of the association held recently at Kosice, Czechoslovakia, in recognition of "merit in engineering science and practice and good rendered to our people." Mr. Hoover was chairman of the Committee on Elimination of Waste in Industry, of the Federated American Engineering Societies, whose report has been translated by the Government of Czechoslovakia and distributed to the industries and educational institutions of that country.

CARL SITTINGER, Winchester, Mass., is now senior engineer with Stone & Webster, Boston, Mass., in the division of engineering and construction. For the past twelve years Mr. Sittinger was associated with John A. Stevens, consulting engineer, Lowell, Mass., as district manager of the Southern New England office and later as a director in the firm. During the War he was in charge of plant engineering for the Bethlehem Loading Co., a subsidiary of the Bethlehem Steel Corp., which was commissioned by the Government to design, construct and operate a large plant for the manufacture of high-explosive shells.

ROY C. MORTON, a civil engineering graduate of the University of North Carolina, has been appointed assistant sanitary engineer in the Tennessee State Department of Health.

JAMES S. WATSON has been made resident engineer, at Philadelphia, for the Bethlehem Steel Co., Bethlehem, Pa.

A. D. DUCK, county engineer of Hunt County, Texas, at Greenville, has resigned to devote his time to the office of city engineer of Greenville which he has held for some time. G. R. Burtner, assistant engineer, has been appointed county engineer.

VAN CAMP, recently assistant engineer of San Augustine County, Texas, and later of Somervell County, has been appointed resident engineer in charge of construction for Tarrant County under D. A. Davis, county engineer at Ft. Worth.

JOPLING-MARSHALL CONST. CO. has opened offices as general contractors at 522 Slaughter Bldg., Dallas. The firm is composed of J. C. JOPLING of Wichita Falls and ALLAN F. MARSHALL of Dallas.

J. C. DUNBAR, president of the Big 4 Engineering Co. and the Anaconda Gravel Co., Ft. Worth, Tex., was recently appointed colonel of the 111th Engineers, 36th Division. Col. Dunbar served as major with this regiment in France.

JOHN W. REID has been appointed Commissioner of Public Works for the city of Detroit to fill the vacancy caused by the resignation of JOSEPH A. MARTIN. Mr. Reid has been connected with the Department of Public Works since 1900 when he entered as a draftsman in the city engineer's office. He was engineer in charge of the grade-separation division from the time it was organized until March 16, 1922, when he was appointed city engineer. The new commissioner has been in close contact with the design and construction work of the department and the present grade-separation activities in Detroit are attributed largely to his efforts. Mr. Reid will appoint a city engineer in accordance with his power as Commissioner of Public Works.

C. E. SLONOKER has resigned as resident engineer with the Tennessee Highway Department and will go into private practice in Johnson City, Tenn.

Obituary

WILLIAM C. CLEMENT, formerly city engineer of Vancouver, B. C., and previous to that assistant city engineer for sixteen years at Toronto, Ontario, died recently at Somenos, B. C., aged 60 years. Mr. Clement had been living on a ranch at Somenos.

FRANK G. DRUM, for many years a leader in business and financial circles in California died in San Francisco on Aug. 28. Three years ago he resigned the presidency of the Pacific Gas and Electric Co., which he had held for thirteen years. At the time of his death he was identified with many financial and public utility organizations of central California and among other offices, held the presidency of the Yosemite Valley R.R. Co. and vice-presidency of the Pacific Portland Cement Co., Consolidated.

From the Manufacturer's Point of View

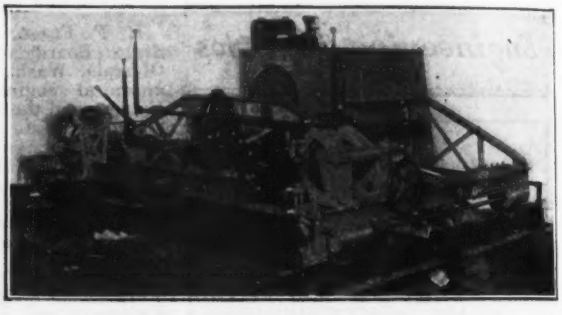
A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Building Concrete Roads in Half Widths Affects Use of Finishing Machine

Manufacturers Point Out Need for Revision of Methods and Equipment to Meet New Conditions Imposed by Road Builders

TO care for traffic during the construction of a concrete road, particularly where detours can not readily be utilized, many of the state highway departments have resorted to the practice of building pavements in half-widths, thus providing a route for vehicles on one side while the other side is occupied by the contractor's operations. As a general rule this form of construction is more costly than if the slab were poured its full width in one operation The argument for it is that the added expense is justified by the service rendered to traffic.

Aside from the economics of this practice, viewed solely from the angle of traffic, another important problem is involved in the use of mechanical equipment for finishing the half-width concrete slabs. Most of the concrete-road finishing machines were originally designed for full-width slabs of 18 ft., more or less. Present practice is calling for the finishing of 9 or 10 ft. slabs, which imposes on the manufacturer of equipment for this purpose the problem of adapting the full-width machine to the half-width slab or designing a new machine for the narrower work. To get the point of view of the manufacturer on this subject *Engineering News-Record* queried several of the makers of finishing machines; their replies follow:



HALF-WIDTH FINISHING ON IDEAL SECTION, LINCOLN HIGHWAY, AND NEW 9-FT. FINISHING MACHINE (LAKEWOOD)

By T. W. Dieckmann

Paving Department, Lakewood Engineering Co., Cleveland

When the method of building concrete roads in half-widths was first proposed we immediately gave attention to the use of the finishing machine on this type of construction. The first half-width, of course, could be machine-finished in the same way as any narrow concrete road. The problem was to finish the second strip.

We developed the method of equipping the finisher with a special set of wheels for the second strip of pavement. The outside wheels, which run on the road forms, are double flanged, while the inside wheels, which travel on the concrete, are flat tread. The outside wheels serve to hold the machine in line with the double flange. When this method was first proposed it was thought it might be necessary to provide a metal plate on the concrete on which the flat-tread wheels could run. Actual operation has shown this to be unnecessary.

This method of building half-width roads was first used on an experimental road in France. That this method is practical was clearly demonstrated by this job, where the finishing machine was handled by men who had not had a great deal of experience with such equipment. This method was also used by J. C. O'Connor & Sons for the construction of the Ideal Section of the Lincoln Highway, a 40-ft. pavement. The contractor used a 20-ft. finishing machine in the above manner with satisfactory results.

We have sold a number of 9- and 10-ft. finishers this year for 18- and 20-ft. roads that are being constructed in half-widths. A photograph of the 9-ft. finisher is reproduced herewith. There is also illustrated the use of the 20-ft. finishing machine on the 40-ft. Ideal Section of the Lincoln Highway.

By Payne G. West

Dunn Road Machinery Co., Conneaut, Ohio

We have discussed ways and means of trying to adapt our present machine to the narrow widths. We can cut down to the 9-ft. width, but not to the 8-ft., as our machine cannot be accommodated to this width. Later this year or next year we will probably go into the matter further and design a new machine, especially prepared for narrow widths. This would of necessity be a lighter and less expensive machine and as a result might fail to accomplish the big results which the present machine is accomplishing. If a demand comes from the contractors for a machine to handle this narrow work, we will build a machine to take care of the demand. It is our understanding, however, that in all cases where these narrow width roads are built, the highway departments offer the contractor the privilege of doing the work by hand instead of by machine and unless we can produce a machine which will be comparatively low-priced the contractor will not be interested.

It is evident that a road built in two sections is going to cost the state and the taxpayers considerably more than the full-width road. From the engineering standpoint there may be some real reason for carrying the work on in this way, but so far I am not convinced that the two halves are as strong or as good as a full-width road, with concrete all across, or with a dividing plate in the middle, as built in some of the states.

By W. J. Savage

Heltzel Steel Form & Iron Co., Warren, Ohio

The use of a full-width finishing machine will not be advantageous on half-width construction if the highway engineers insist on leaving half the road open to permit the passing of traffic alongside new construction where detours are not available. Further, we do not believe the method is practical even if the road were closed to traffic, as it would necessitate the setting of forms three times, putting the contractor to considerable expense. Even if this expense were disregarded, when the contractor started pouring the second half of the road, the tamper would be constantly hitting the finished road, causing some damage. Even this method would be impractical, as the finished half of the road would necessarily be covered either with straw or dirt for curing purposes, which would interfere with the proper functioning of the tamper strikeoff and belt.

We will shortly have a 9-ft. machine in operation on a half-width road. The use of a full-width machine on half-width construction is an expense to the contractor, unless of course provisions are made by the state highway department to repay the contractor for the additional cost

By A. W. French & Co.

Chicago

Regarding finishing machines for different widths of road, our Ord concrete road surfacing machine is built in widths of 9 to 20 ft. and we have

a part which is standard for changing over from a 20-ft. machine down to 9-ft. machine.

Cement Production Returns 7.3 Per Cent on Investment

A return of 7.3 per cent on the total investment during 1922 is indicated by an analysis of the federal income tax statements of 11 of the principal Eastern cement companies producing 75 per cent of the cement manufactured in the Eastern states. This is the conclusion reached by H. Parker Willis, Professor of Banking at Columbia University, New York, to whom the companies submitted their operating figures for analysis and report. "It would appear," says Professor Willis, "that whether viewed as a return upon business turned over or upon the value of the output or as a return upon actual investment, the earnings of representative cement producers during 1922 have been well below the average obtained by industrial undertakings at large. The 11 companies under study materially reduced their prices during 1922, receeiving on the average $0.15257 less per barrel than in 1921. This figure represents the difference between an average 1921 price of $1.75453 and a price for 1922 of $1.60196."

For the 11 companies under consideration the output was 28,774,191 barrels or about 25 per cent of the entire production of the country as a whole. Gross sales of 11 companies, comprising both new and old products, were worth $49,592,872. The aggregate net worth of the invested property of the concerns, as reported, was $87,003,767. On the actual investment, Professor Willis states, the 11 mills have earned a total net income, after expenses and taxes, amounting to $6,363,461 or an average return of about 7.3 per cent for the entire group. Total cash dividends declared during the year 1922 were $2,278,634, or an average percentage slightly over 3.5 on a total capitalization of $64,664,061.

The largest percentage of return, the report points out, is by no means obtained by the largest companies.

Fence Manufacturers Favor Simplified Standards

Eighty per cent of the manufacturers of farm, field, and poultry woven-wire fences of the United States, representing over 90 per cent of the country's annual production of that commodity, have signified their intention of accepting the simplified practice recommendation promulgated at the Commerce Department, July 11 and 12.

Woven wire fence manufacturers, distributors, and consumers, representing at least 85 per cent of the national capacity, met with W. A. Durgin, Chief of the Division of Simplified Practice, at the Department of Commerce, in July, in an effort to get together on some mutually satisfactory plan for eliminating excessive varieties of styles and containers existent in that industry. As a result, this conference recommended a reduction from 552 styles of woven wire fence to 69; and a reduction from 2,072 sized packages to 138. This means an 87.5 per cent elimination in the former, and a 93.4 per cent elimination in the latter.

Injunction Granted in Zeolite Water Softener Suit

The Permutit Company, New York, recently brought suit in the Federal Court in New York City against the Paige & Jones Chemical Co. for infringement of the Permutit company's patent covering zeolite water softening apparatus that had previously been sustained by the District Court at Buffalo and the Circuit Court of Appeals, New York. At a hearing in July in the Federal Court, New York City, Judge Learned Hand granted an injunction against the Paige & Jones Chemical Co. restraining it from further manufacturing or selling of infringing apparatus. The first suit in this patent, which was against the Refinite Co. of Omaha, Neb., was carried to the Supreme Court of the United States which denied a writ of certiorari to review it.

Business Notes

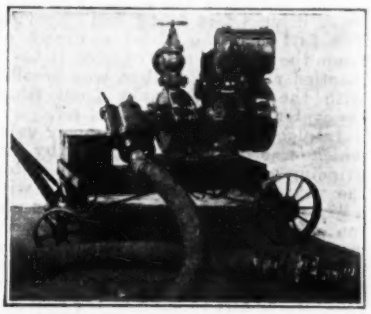
J. H. KEMPSTER has been appointed general superintendent of the Buffington plant of Universal Portland Cement Co. located at Buffington, Ind., succeeding the late C. O. Soderquist. This plant consists of mills No. 3, 4 and 6. In 1907, two years after graduation as chemical engineer from the University of Michigan, Mr. Kempster entered the service of the company as chemist of the plant at South Chicago. In 1908 he was appointed chemist of the Buffington plant and in 1915 was advanced to the superintendency of mills No. 3 and 4. Three years later he became superintendent of mill No. 6 which position he has held until his present appointment as General Superintendent of the Buffington plant.

JOHN F. CUNNINGHAM, JR., has been appointed assistant manager of the production department of the Schenectady works of the General Electric Co. In 1901, after a service of two years with the Hoosic Falls Power & Light Co. on power station and line work, he entered the employ of the General Electric Co. in the armature department. In 1906, he was transferred to the turbine section of the production department and later became assistant to the production manager, in charge of requisition service. In 1919, he was transferred to the works manager's office in the capacity of special representative.

Equipment and Materials

Light Portable Pump Driven by Air-Cooled Gas Engine

Weighing 780 lb. and with a capacity of 50 gal. per minute against a total head of from 30 to 35 ft., the portable pumping unit, manufactured by the Pennsylvania Pump & Compressor Co., Easton, Pa., is designed particularly for contractors' use in unwatering excavations, pumping out sewers and delivering a supply of water for concrete road construction. The pump, as shown in the accompanying illustration, is mounted on a four-wheeled hand truck. Power is furnished by a 5-hp. New Way air-cooled gasoline engine, on the shaft of which is mounted directly a 3-in. centrifugal pump. The pump is of the single-stage side suction type with open impeller. The advantages of the air-cooled engine, the manufacturer points out, are its light weight, as compared with a water-jacketed cylinder, and the impossibility of trouble due to frozen



cylinders or clogged circulating pump or piping. That portion of the engine's shaft extending into the pump and exposed to the action of the liquid is covered with a bronze sleeve to prevent corrosion.

Water-Measuring Tank for Concrete Mixers

The new water-measuring tank, designed by The T. L. Smith Co., Milwaukee, for use on its concrete mixers and pavers, consists of an open-top trough, pivoted at both ends within the watertight outer shell of the tank. By tilting this trough at different angles, it is made to hold more or less water and in this way to regulate the amount of water that can be drawn from the tank. The action of this trough can be understood by taking up the operation of the tank, step by step:

Consider that the trough is in an upright position. The operator first allows water to run into the tank until it is full. Then he opens the valve at the bottom of the tank and allows the water to run out into the mixer drum.

The amount of water that runs out is equal to the tank full less the amount held in the trough. Tilting the trough so that it will retain less water permits more water to flow from the tank. When the trough is tilted to a position where it will no longer hold any water, the entire capacity of the tank can be drawn off.

A short arm at the end of the tank enables the operator to set the trough

in the position that will allow just the right amount of water to be drawn off for each batch. A graduated sector, along which this arm rotates, indicates the amount of water being used. A lock is provided to lock the arm at any point along the sector if desired.

The water enters and empties from the tank through a 2½-in. valve located at the bottom of the tank. This large valve insures fast filling and emptying. The fact that the water is drawn off from the bottom also enables it to be emptied much faster than was possible with the old-style tanks from which the water had to be siphoned off.

In place of the usual three-way valve which was liable to damage by the grinding action of the dirt in the water, the new Smith tank is equipped with a piston-type, two-way valve. The piston operates horizontally and the seating surfaces, which are rubber and finished cast-iron, are in a vertical position. This makes it practically impossible for dirt to cling to the seating-surfaces because the incoming and outgoing water is continually washing them clean. Any dirt that may be caught in the valve will drop to the bottom of the valve housing where it can do no damage and from which it can be drained off occasionally through a small plug.

Publications from the Construction Industry

Concrete Floors—PORTLAND CEMENT ASSOCIATON, Chicago, has published a 16-p. pamphlet containing the American Concrete Institute's tentative standard specifications for concrete floors. The text covers materials, construction, plain and reinforced concrete floors, two-course and one-course floors and heavy duty floors for industrial buildings. Suggestions are offered for hardening and increasing the density of floor surfaces and coloring them.

Mechanical Snow Handling—BARBER-GREENE CO., Aurora, Ill., has just published a 20-p. illustrated pamphlet on the general subject of snow removal with particular reference to the use of mechanical equipment. General descriptions and operating data are presented for the company's new type of elevating snow loader which is now in service in a number of cities.

Concrete Mixers—FOOTE CONCRETE MACHINERY CO., Chicago, has issued a 24-p. illustrated pamphlet on its 14-E and 21-E crawler traction paving mixers. The text describes in detail the principal parts of this equipment including traction, frame, drum, power plant, loading skip, spreader bucket and power loading derrick. One page is devoted to the company's transport trailer for moving paving mixers rapidly from one job to another.

Concrete Mixers—T. L. SMITH CO., Milwaukee, is distributing a small folder descriptive of two of the Smith line of concrete mixers—the new 4-S tilter (half-bag) and the 7-S non-tilting mixer (full-bag). Special reference is made to the newly designed and much simplified device which is now used on the 7-S for operating the discharge chute.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Slight Change in Lumber Movement

Production of lumber in the United States, as reflected by 390 of the larger commercial sawmills of the country, was about the same for the week ending Aug. 18 as for the preceding week, says the National Lumber Manufacturers Association. Shipments showed an increase of about 3 per cent and new business a decrease of approximately 3 per cent. With 128 mills reporting as against 122 for the week before unfilled orders of West Coast mills increased from 305,893,356 to 325,860,186 ft., and 137 Southern Pine mills showed a decline in their order file from 231,411,399 to 223,839,786 ft.

For all the reporting mills, shipments were 85 per cent and orders were 76 per cent of actual production; for the Southern Pine Association mills these percentages were 94 and 85 and for the mills of the West Coast Lumbermen's Association, 89 and 84 per cent. Of the entire number of reporting mills, 359 reported normal production for the week, in relation to which actual production was 108 per cent; shipments 94 and orders 85 per cent.

For the first 33 weeks of 1923 and the corresponding weeks of 1922 the lumber movement of reporting mills was as follows:

	Production	Shipments	Orders
1923....	8,267,570,284	8,287,450,163	8,193,307,092
1922....	6,942,857,907	6,900,666,282	7,405,047,392
1923 Increase	1,324,712,377	1,386,783,881	788,259,660

Wholesale Prices Decrease

The index number of wholesale prices in the United States, compiled by the Federal Reserve Board for the purpose of international comparisons, decreased 5 points in July as compared with a decrease of 2 points in June. There were declines in all groups, Goods Produced falling 4 points; Goods Imported, 7 points; Goods Exported, 8 points; Raw Materials, 8 points; Producers' Goods, 4 points; and Consumers' Goods, 1 point.

INDEX NUMBERS OF WHOLESALE PRICES IN THE UNITED STATES
(1913 = 100)

	Goods Produced	Goods Imported	Goods Exported	Raw Materials	Producers' Goods	Consumers' Goods	All Commodities
1922:							
July	162	128	165	177	143	163	165
October	161	135	163	179	150	156	165
1923:							
January	162	139	180	182	150	156	165
April	165	156	186	181	169	158	169
May	162	155	179	176	167	158	166
June	159	148	182	171	164	157	164
July	155	141	170	163	160	156	159

The index number is compiled from 100 wholesale price quotations for representative commodities taken in leading United States markets, weighted according to the importance of the commodity. Part of the quotations used are furnished by the Bureau of Labor Statistics, the rest are compiled from trade journals and private firms of recognized authority.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 129 to 142, are the following:

Dam, Danville, Ky., to L. E. Meyer, Chicago, $4,000,000.

Schools, Brooklyn, N. Y., to Lustbader Constr. Co. and G. A. Fuller, $1,012,000 and $2,492,000, respectively.

Gas container, Milwaukee, Wis., to Riter-Conley Co., Pittsburgh, Pa., $1,500,000.

Bank and office building, Miami, Fla., to R. C. Miller and Ingalls Iron Works, Birmingham, $1,500,000.

Schools, New York, N. Y., to T. A. Clark Co., Brooklyn, P. J. Brennan & Son and Frymier & Hana Co., Inc., $937,700, $1,054,000 and $905,480, respectively.

Bank and office building, Cleveland, O., to Hunkin-Conkey Constr. Co., $1,000,000.

Apartment, Long Beach, Calif., to Ransford-Goble Co., Los Angeles, $1,000,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 129 to 142, are the following:

Bridge, Jacksonville, Fla., for Florida East Coast Ry., St. Augustine, $1,800,000.

Bank and office building, Pasadena, Calif., for Pacific Southwest Trust & Savings Bank, $1,300,000.

Freight Loadings Continue Heavy

Loading of revenue freight, according to the Car Service Division of the American Railway Association, continues to run the heaviest for this time of year in the history of the United States. From Jan. 1 this year until Aug. 18, inclusive, (a period of 33 weeks) 30,999,244 cars were loaded with revenue freight. This is the largest number loaded during any corresponding period in history, exceeding by 5,195,251 cars the corresponding period last year, and by 6,904,844 cars the corresponding period in 1921.

For the week ended Aug. 18, 1,035,741 cars were loaded, the second highest total for any one week in history. This was only 5,303 cars under the record week of July 28, when, 1,041,044 cars were loaded. Compared with the corresponding week last year, this was an increase of 189,475 cars or 22.4 per cent, while it also was an increase of 220,594 cars over the corresponding week in 1921.

Value of August Contracts Nearly Twelve Per Cent Under Same Month Last Year

Total of 820 Awards During August, Average Value $172,681 Compared With 755 in July, Averaging $216,502

Contracts awarded in the five issues of *Engineering News-Record* during August totaled $141,599,000 as compared with $163,459,000 in the four issues of July. This represents an average weekly value of $28,319,800 for August, against $40,864,750 during the preceding month.

The weekly average of $28,319,000 for the month of August represents a decrease in money value of 12½ per cent below the weekly average for the corresponding period in 1922. August 1922 contracts totaled $160,130,000.

The number of awards totaled 820 during August, with an average value of $172,681 as compared with 755 in July, averaging $216,502.

Minimum costs observed in Construction News on each class of construction are as follows: Water-works, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

Of the $141,599,000 a total of $13,442,000 represented Canadian awards, which gained slightly over the July lettings.

All classes of construction fell off during August except industrial works and sewers. August sewer contracts more than doubled those of July, in total money value, and industrial works gained over 25 per cent during the month.

Among the large industrial projects awarded during August were the following: hydro-electric power plant at Island Portage, Ont., $4,000,000 to $5,000,000; a cement plant at Ft. Worth, Tex., $1,000,000; an addition to a cement plant at Bonner Springs, Kan., $1,000,000. The largest sewer contract involved the construction of sewage treatment works at Chicago, Ill., $5,602,636.

The actual physical volume of construction represented by August contracts is 28 per cent less than August, 1922, and 5 per cent under 1921, but 37 per cent heavier than August, 1920.

Engineering News-Record Construction Cost Index Number

September, 1923	221.50
August, 1923	221.50
September, 1922	185.00
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number, 221.50, for September, is exactly the same as for the preceding month. Prices of basic building materials remained unchanged during the month. The average rate for common labor is still 54c. Thus, general construction cost is 20 per cent higher than one year ago and 19 per cent under the peak; it is 121 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly

August, 1923 (*5 issues of E. N.-R.*)	111
July, 1923 (*4 issues of E. N.-R.*)	128
August, 1922 (*5 issues of E. N.-R.*)	154
1913	100

Yearly

1922 (entire year)	130
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 111 for the month of August, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 111 for August, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING AUGUST, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total United States	Canada	Total
Water-works	$135,000	$208,000	$152,000	$1,648,000	$1,012,000	$42,000	$3,197,000	$481,000	$3,678,000
Sewers	.....	2,194,000	455,000	7,617,000	595,000	2,743,000	13,604,000	149,000	13,753,000
Bridges	102,000	1,049,000	672,000	1,617,000	308,000	500,000	4,248,000	.....	4,248,000
Excavation, drainage and irrigation	.....	.....	108,000	322,000	916,000	991,000	2,337,000	.....	2,337,000
Streets and roads	1,075,000	9,189,000	7,310,000	6,748,000	7,356,000	3,161,000	34,839,000	800,000	35,639,000
Industrial works	895,000	2,515,000	476,000	3,795,000	3,407,000	1,791,000	12,879,000	6,483,000	19,362,000
Buildings	2,005,000	11,818,000	1,926,000	11,750,000	9,616,000	11,991,000	49,106,000	1,957,000	51,063,000
Federal Government	46,000	1,779,000	285,000	238,000	90,000	98,000	2,536,000	.....	2,536,000
Miscellaneous	50,000	2,181,000	590,000	690,000	1,662,000	238,000	5,411,000	3,572,000	8,983,000
August, 1923	$4,308,000	$30,933,000	$11,974,000	$34,425,000	$24,962,000	$21,555,000	$128,157,000	$13,442,000	$141,599,000
July, 1923	8,897,000	34,633,000	24,065,000	42,044,000	25,666,000	19,718,000	155,023,000	8,436,000	163,459,000
June, 1923	10,193,000	43,357,000	15,373,000	58,783,000	29,945,000	20,936,000	178,587,000	10,199,000	188,786,000
Total 3 months	$23,398,000	$108,923,000	$51,412,000	$135,252,000	$80,573,000	$62,209,000	$461,767,000	$32,077,000	$93,4844,000

Labor Rates and Conditions Throughout the Country

Continued advances in cost of food and clothing and further increases in rents, during the period between June 15 and July 15, 1923, resulted in an increase of 1.1 per cent in the cost of living throughout the country, according to reports of the National Industrial Conference Board. Living costs on July 15, of the current year, were 61.9 per cent higher than in July, 1914. Fuel prices, however, were a trifle lower, while average sundries and light charges remained unchanged.

Wage changes in the United States during the month ended Aug. 14, 1923, totaled seventy-seven, all of which were increases. The wage advances occurred as follows: Printing industry, 27; railroads, 14; building trades, 10; metal working trades, 8; street railways, 6 and miscellaneous industries, 12.

The average rate paid common laborers, pick and shovel men in construction operations, remains at 54c., the same as for July and August as against 53c. per hr. during June, according to *Engineering News-Record* figures. Local building conditions are as follows:

Baltimore—Conditions easing up in employment of carpenters, bricklayers and hodcarriers. Hoisting engineers advanced 10@12½c.; common laborers, 10c. per hr.

Birmingham — Plasterers increased from $1 to $1.25 per hr.

Boston—Scarcity of bricklayers and hodcarriers; attracted to other cities by higher wage rates. Hoisting engineers' rate at maximum of $1.35, against $1.25 per hr. formerly.

Chicago—Three of the largest building constructors in Chicago have withdrawn from the Landis Award Committee and begun to unionize their work.

Dallas—Increased demand for bricklayers and carpenters; building active.

Detroit—Masons and plasterers in

CURRENT BUILDING TRADES WAGE RATES PER HOUR
(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.90	$0.70	$0.50	.....	$0.75	$0.30@.35
Baltimore	1.50	1.00	.90@1.12½	.87½	$0.65	.80@1.00	+ .40@.50
Birmingham	1.00	1.00	.50@1.00	.30@.40	.....	1.25	.30@.40
Boston	1.25	1.05	1.25@1.35	.82½	1.05	1.12½	.55@.70
Cincinnati	1.25	1.05	1.05	.82½	1.05	1.05	.45
Chicago	1.25	1.15	1.00@1.25	.88¾	1.10	1.25	.82½
Cleveland	1.40	1.25	1.25	.87½	1.00	1.10	.87½
Dallas	1.50	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	1.37½@1.50	1.12½	1.12½@1.18¾	.75@.81¼	1.00	1.15⅝	.35@.55
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.37½	1.00	1.00@1.25	—.87½	1.00	1.07½	.35@.60
Los Angeles	1.25	.87½@1.00	.87½@1.00	.62½	.....	1.00	.50
Minneapolis	1.12½	.87½	.87½	.71⅛	.....	.87½	.50@.55
Montreal	1.00	.65	.50	.35	.50	.65	.30
New Orleans	+1.25	.90	+1.00	.65	.80	1.00	.35@.40
New York	1.50	1.25	1.25@1.50	1.00	1.00	1.25	.65@.75
Philadelphia	+1.50	1.12½	+1.02½	.70@1.00	1.00	1.10@1.12½	—.45@.50
Pittsburgh	1.40	1.20	1.12½	1.00	.....	1.25	+.70
St. Louis	1.50@1.75	+1.25@1.50	1.25@1.37½	1.25	1.25	1.25@1.50	—.45@1.00
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.12½	1.00	1.00	.93¾	1.00	1.12½	.50@.62½

good demand. Conditions normal in all trades.

Kansas City—Structural iron workers now receiving $1.07½; will demand $1.25 per hr., effective Sept. 1.

Los Angeles—All building crafts busy; no labor shortage.

Montreal—Scarcity of carpenters, bricklayers and hodcarriers; other crafts ample.

New Orleans—Carpenters' strike still on, but effect on construction is negligible. Bricklayers granted increase of 25c. and structural iron workers, 10c. per hr. Strike of metal workers threatened Sept. 1.

New York—Base pay for carpenters $9, with bonus of $1 per day, effective June 1. Cement and concrete laborers $6.50, with bonus of $1 per day, effective July 16. Hoisting engineers' base wage $10, but when employed on jobs where bricklayers are working, both receive same rate.

Philadelphia—Situation easier with bricklayers; over-supply of carpenters. Plenty of other trades. No employment for pile drivers at present.

Pittsburgh—Scarcity of bricklayers; plenty of other crafts. Change from 12-hr. to 8-hr. shifts in steel mills will result in wage advance of about 25 per cent. Several thousand additional workers will be required under the new schedule.

St. Louis—Bricklayers will demand $1.75 per hr. after Nov. 1. Many being paid $14@$15 per day at present. Carpenters' scale to be $1.50, effective Oct. 1. Decided slackening in demand for building trades mechanics due to falling off in new projects. Surplus of workers noticeable in some crafts.

San Francisco—Building trades mechanics busy despite slow-down.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Market spotty. Sales reported as low as $24 per ton at Birmingham for No. 2 foundry; $27 demanded on small lots for immediate delivery, against $25, one month ago. August business heaviest since spring. Furnaces facing higher fuel costs; spot coke market up.

Railway Supplies—Heavy buying movement developed in steel rails, which form the largest item in steel exports. Railway ties tending higher. Fairly active demand for railroad equipment; prices firm.

Pipe—No changes in prices of wrought steel and iron pipe; demand improved. Cast-iron pipe higher in New York. Sewerpipe lower at Pittsburgh; advanced in Kansas City and Boston.

Road and Paving Materials—Asphalt, package and in bulk, advanced in Boston and declined in Cincinnati, during month. Granite paving blocks up $4.75 per M. in Montreal; down $2 in Boston. Wood blocks also declined in Boston, 10c. per sq.yd.

Sand, Gravel and Crushed Stone—Gravel, ¾-in., dropped 10c. in Boston and 25c. per cu.yd. in Los Angeles. Sand, however, advanced 10c. per ton in Cincinnati. Crushed stone, ¾-in., up 30c. in St. Louis and 33c. per cu.yd. in Dallas due to freight and labor adjustments; down 25c. in Los Angeles and 10c. per ton in Boston, during month.

Lime—Hydrated finishing, up 50c.; common, $1 per ton in Boston; lump, finishing and common, advanced 15c. per bbl. Los Angeles reports drop in common lump.

Cement—St. Louis reports advance of 10c. and Atlanta, 15c. per bbl. during the month. New Orleans, however, dropped 40c. Prices prevailing in Chicago, Detroit, Indianapolis, Milwaukee, Pittsburgh and two or three other points are the same as those in effect one year ago.

Structural Steel—August steel business slower than for any previous month since October, 1921. Prices firm despite dullness of market. Inquiries for steel plates and shapes plentiful, but mills finding difficulties in meeting delivery specifications. Plates and shapes firm at $2.50 per 100 lb., f.o.b. mill. Demand for shapes mostly in small lots. Bars firm at $2.40, with demand improving.

Brick and Hollow Tile—Common brick, $20 per M., alongside dock, New York, against $21@$22, one month ago and $18@$20, one year ago. Decline of 50c. per M. reported in Los Angeles and Detroit. Boston, however, quotes rise of $1. Hollow tile down in New York and St. Louis; higher in Los Angeles.

Lumber—Demand slack, due to seasonal dullness. Production and shipments low; stocks large; plenty of cars. August market weaker than preceding month. Price declines reported in San Francisco, Chicago, Boston, Minneapolis, Kansas City, Detroit, and St. Louis. Denver, however, quotes advances in fir and hemlock.

Explosives—Dynamite, 40 per cent gelatin, up in Boston and St. Louis; down in Kansas City; 60 per cent, higher in Boston and lower in Kansas City.

Scrap—Iron and steel scrap higher than month ago in New York and St. Louis, particularly in heavy melting steel. Market firm with increase in fuel prices.

Linseed Oil—Raw oil dropped 9c. in New York and 14c. per gal. in Chicago since Aug. 1. Declines reported in Atlanta, Minneapolis and San Francisco.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Sept. 6	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$29.05@31.05	$25.05
Northern Basic	28.17	28.27
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	28.27	32.27
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	34.37	32.44
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	25.00@27.00	27.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	29.16	33.64
Virginia No. 2 (silicon 2.25 @ 2.75)	32.17	31.17
Basic	26.16	31.14
Gray Forge	26.16	31.50
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	28.61	30.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	30.51	28.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	27.77	33.00
Basic	26.77	26.00
Bessemer	28.77	30.00

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$15.00	$11.50	**16.00**
Stove plate	**12.00**	12.00	**15.00**
No. 1 machinery cast	17.00	16.50	**20.00**
Machine shop turnings	*8.00*	4.00	**12.00**
Cast borings	*9.00*	5.50	**13.00**
Railroad malleable cast	**15.00**	12.50	**20.00**
Re-rolling rails	13.00	13.00	**19.00**
Re-laying rails		30.00	**28.50@36.50**
Heavy melting steel	**12.00**	.....	.....

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	Sept. 6	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40.00	.....	$43.00	$43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00	43.00
Light rails, 8 to 10 lb.	45.00	38.00	2.00*	43.00	43@45
Light rails, 12 to 14 lb.	45.00	38.00	2.00*	43.00	43@45
Light rails, 25 to 45 lb.	45.00	38@40	2.00*	43.00	43@45
Rerolled Rails	18.75@19.25	24@29.50	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.50	$1.65
Chicago, Hardwood and Red Oak	1.25	1.40†
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco..... Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted, Douglas Fir	1.70	2.25
St. Louis, White Oak	1.30	1.55
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1.20	1.45
St. Louis, Sap pine-cypress	1.05	1.30

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	Sept. 6	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅞-in. and larger	$3.15	$2.35@2.50	$3.00	$4.00	$4.00	$3.75
Track bolts	4.00@4.25	3.25@3.50	4.00	5.00	*5.00*	4.70
Standard section angle bars	2.75	2.40	2.75	4.00	*4.00*	3.10

PIPE

WROUGHT PIPE—The following mill discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	62	50½	1 to 1¼	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1¼	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	New York	Black Chicago	St. Louis
1 to 3 in. butt welded	48%	50%	49%
2½ to 6 in. lap welded	44%	47%	46%

	New York	Galvanized Chicago	St. Louis
1 to 3 in. butt welded	34%	37%	36%
2½ to 6 in. lap welded	30%	34%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 15%. Cast iron, standard sizes, 17½% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Sept. 6	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	$53.00	$58.60	$60.30	$64.20	$61.60	$66.00
6 in. and over	49.00	63.60	55.30	60.20	57.60	62.00

Gas pipe and Class "A," $5 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

	New York					
Size, In.	Sept. 6	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$40.00	$50.00	$62.50	.....	$73.00
4	55.00	53.00	50.00	75.00	$76.50	83.00
5	80.00	80.00	.....	100.00	97.75	108.00
6	105.00	100.00	85.00	175.00	127.50	133.00
8	170.00	160.00	195.00	187.50	212.50	199.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car lead lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	*$0.105*	.....	.....	$0.15	$0.12	.....
4	.....	*.105*	$0.11	$0.1175	.15	.15	$0.15
5	.....	*.1575*	.1375	.....	.23	.18	.18
6	$0.24	*.1575*	.165	.1645	.23	.21	.21
8	.38	*.245*	.26	.26	.35	.30	.325
10	.57	*.3675*	.338	.364	.53	.42	.476
12	.72	*.4725*	.442	.468	.68	.54	.612
15	1.13†	*.63*	.65	.78†	.90	.90	.884
18	1.65†	*.875*	.85	1.092†	1.25	1.32	1.153
20	1.98†	*1.05*	1.125	.....	1.50	.....	1.564
22	2.64†	*1.40*	1.375	1.456†	2.00	.....	2.04
24	2.97†	*1.575*	1.625	1.872†	2.25	2.16	3.34
27	4.81†	*2.795*	.....	2.95†	4.69†	3.00	4.06
30	5.33†	*3.096*	.....	3.65†	5.94†	3.60	4.99
33	6.93†	*4.14*	.....	4.45†	6.88†	.....	5.42
36	7.91†	*4.715*	.....	4.80†	7.50†	.....	

	3	5	8	12	24	36
Boston	**$0.129**	**$0.199**	**$0.315**	**$0.603**	**$1.99†**	$5.95†
Minneapolis	.....	.....	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	.....	.36	.72‡	2.60†	.....
Los Angeles	.13	.165	.275	.475	1.65	.....
New Orleans	.112*	.168*	.28	.476	1.182	.....
Cincinnati	.12	.18	.28	.54	1.80	4.10†
Atlanta	1.05*	.16*	.27	.455	1.75	.....
Montreal, delivered	.68‡	.45†	.70	1.35	4.50†	
Detroit	.117	.1755	.273	.5265	2.34†	6.15†
Baltimore	.126	.189	.294	.567	1.89	5.4375
Kansas City, Mo.	.15*	.21*	**.33‡**	**.56**	1.80	5.22‡
Philadelphia	.12	.18	.28	.54	1.80	5.22‡

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		Sept. 6	One Year Ago
New York, 45% asphalt	(at terminal)	**$0.053**	$0.055
New York, 65% asphalt	(at terminal)	*.052*	.055
New York, binder	(at terminal)	.06	.0625
New York, flux	(at terminal)	**.06**	.06
New York, liquid asphalt	(at terminal)	*.048*	.065
St. Louis, 50@60% asphalt		.0565	.05
St. Louis, 40@50% asphalt		.0535	.....
Chicago, 40–50% asphalt		.0525	.0525
Chicago, 60–70% asphalt		.055	.055
Dallas, 45% asphalt		**.0495**	.10
Dallas, 55% asphalt		.0455	.13
Dallas, binder		.061	.15
San Francisco, binder, per ton		9.50*	13.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbl. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*)	$23.00*	$15.00†
Boston (*Mexican*)	**21.50**	**17.50**
Chicago (*Stanolind*)	22.25	16.00
San Francisco, *f.o.b. refinery*, Oleum, Cal	17.00	11.00
Dallas (*Texas*)	27.10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	24.75	20.50
Denver (*California*)	24.00	....
Minneapolis *f.o.b. Twin Cities (Stanolind)*	25.45	19.10
St. Louis (*Mexican*)	29.50	24.50
Baltimore (*Standard Oil*)	21.00	15.00
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	26.00	23.50
Detroit (*Mexican*)	22.47	18.40
Cincinnati (*Kentucky Rock*)	*17.50*	*13.50*
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	21.50	18.50
Philadelphia (*Mexican*)	20.00	15.00
Kansas City (*Texas*)	27.30	22.30
Los Angeles "*D*" *grade, California, f.o.b. El Segundo Refinery*	17.00	11.00

*F.o.b. Bayonne, N. J.
†F.o.b. Marcus Hook, Pa.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq.yd.	$134.50 per M.
Chicago	About 4x8x4 dressed	3.50 per sq.yd.
	About 4x8x4 common	3.10 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite, 28 blocks per sq.yd.	*128.00* per M.
Atlanta	Granite	2.66 per sq.yd.
Detroit	5-in. Granite	106.00 per M.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	**104.75** per M.
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	138.00 per M.
St. Louis	4x8x4 dressed	3.15 per sq.yd.
	4x8x4 common	2.95 per sq.yd.
Kansas City	Granite	3.55 per sq.yd.
Philadelphia	Granite	3.75 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1.10 per lin.ft.
Chicago	18 in. wide	.... per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 80c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., $1.45 per lin.ft. *Chicago*: 5 x 8 in., $1.65; 6 x 8 in., $1.95 per lin.ft. delivered.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.58
New York (*delivered*)	3½	16	2.79
Boston	3½	18	*2.55*
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	2.55
St. Louis	4	16	2.90
Seattle	4	16	Off market
Minneapolis	3½	16	2.73
Atlanta	3½	16	2.00
New Orleans	3	16	2.45
New Orleans	3½	16	2.65
New Orleans	4	16	2.95
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	3½	16	2.38
Kansas City	4	16	2.75
Philadelphia	4	16	None used

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	Sept. 6	One Year Ago	Sept. 6	One Year Ago	Sept. 6	One Year Ago
New York	$1.75	$1.75	$1.75	$1.75	$1.25	$1.00
Denver	1.90	1.75	1.90	1.75	1.00	0.75
Chicago	2.00	2.00	2.00	2.00	2.00	2.00
St. Louis	2.30	1.25†	2.35	1.30†	2.10	1.10†
Seattle	1.25	1.00	1.25	1.00	1.25	1.00
Dallas	2.38	2.25	2.38	2.25	1.89	2.25
Minneapolis	1.85*	1.75	1.85*	1.75	1.25	1.00
Cincinnati	1.50†	1.87½	1.50†	1.87½	**1.30†**	1.43
San Francisco	2.15	2.25	2.15	2.25	1.50	1.50
Boston	*1.40†*		*1.40†*		*1.10†*	
New Orleans	2.85	2.85	2.85	2.85	1.25	1.35
Los Angeles	*2.50*	1.50†	*2.50*	1.50†	1.75	1.35†
Atlanta	1.90†	1.85†	1.90†	1.85†	1.24†	1.15†
Detroit	1.62	2.00	1.62	2.00	2.02½	2.00
Baltimore	1.86	1.40	2.06	1.60	0.80†	2.00†
Montreal	1.25†	1.25†	1.50†	1.50†	1.25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.30†	1.28†
Philadelphia	2.00†	1.60	2.00†	1.65	1.50†	1.60
Kansas City	1.75	2.00†	1.60	2.00†	0.66†*	0.66†*

New York—Grits, $1.75 per cu. yd.; ready mixed, $2.00
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city unless stated otherwise, is as follows, per cu.yd.:

	1½ In.		¾ In.	
	Sept. 6	One Year Ago	Sept. 6	One Year Ago
New York	$1.65	$1.65	$1.75	1.75
Chicago	2.00	1.60	2.00	1.60
St. Louis	1.90	1.65	**2.00**	1.65
Dallas	**2.83**	1.65	**2.83**	1.55
San Francisco	2.15	2.25	2.15	2.25
Boston	*1.60**	....	*1.60**	....
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City	1.50	2.10	1.50	2.10
Denver	3.50	3.50	3.50	3.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.00*	1.90*	2.00*	2.00*
Cincinnati	1.65*	1.75	1.65*	1.75
Los Angeles *delivered*	*2.75*	1.75*	*3.00*	1.85*
Detroit	1.75	1.90*	1.75	1.90*
Baltimore	2.50	1.75*	2.55	1.65*
Montreal	1.80*	1.50*	1.90*	2.00*
Philadelphia	2.00*	1.70*	2.00*	1.55*
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.00*	3.25*	3.00*

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa	0.85	0.90	2.50	....
Birmingham, Ala	1.05	1.15	2.05	0.80
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.45	1.45	1.45	1.25
Eastern Pa. and Northern N. J	1.20	1.20	2.50	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25
Longdale and Glen Wilton, Va	1.25	1.25	2.50	1.00
Toledo, Ohio	1.50	1.50	1.50	1.50

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$18.20	$13.10	$3.75*	$3.00@3.25*
Chicago	20.00	20.00	1.50†	1.50†
St. Louis	23.20	20.00	1.87½†	1.87½†
Boston	**22.50**	**16.00**	**4.30***	**2.60***
Dallas	22.00	22.00	....	2.35†
Cincinnati	16.80	14.30	....	....
San Francisco	22.00	.....	....	2.10†
Minneapolis	25.50	21.00 (white)	1.70†	1.50†
Denver	24.00	.....	....	2.70†
Detroit	21.00	20.00	....	20.00‡
Seattle, *paper sacks*	24.00	.....	2.80†	....
Los Angeles	.....	18.50	....	*2.00†*
Baltimore	24.25	17.25	2.55	....
Montreal	.....	21.00	....	10.00‡
Atlanta	22.50	*14.00*	*2.25†*	1.50†
New Orleans	.....	.....	2.40†	1.85†
Philadelphia	23.50	16.50	2.80*	1.93*
Kansas City	28.00	24.00	3.12*	2.96*
Birmingham	14.25	13.50	1.90†	1.65†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.80, Sheboygan $1.70. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Sept. 6	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.50	1.60
Cincinnati (Utica)	1.72	1.77
Boston (Rosendale)	**2.80**	
St. Louis (Carney)	*2.35*	1.87
Birmingham (Magnolia)	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Sept. 6	One Month Ago	One Year Ago
New York, del. by truck	$2.70@2.80	$2.70@2.80	$2.60
New York, alongside dock to dealers	2.30	2.30	2.30
Jersey City	2.48	2.48	2.73
Boston	2.90	2.90	
Chicago	2.20	2.20	2.20
Pittsburgh	2.24	2.24	2.24
Cleveland	2.46	2.46	2.59
Detroit	2.48	2.48	2.48
Indianapolis	2.41	2.41	2.41
Toledo	2.48	2.48	2.53
Milwaukee	2.37	2.37	2.37
Duluth	2.25	2.25	2.14
Peoria	2.41	2.41	2.41
Cedar Rapids	2.48	2.48	2.48
Davenport	2.43	2.43	2.43
St. Louis	**2.45**	2.35	2.20
San Francisco	2.63	2.63	2.71
New Orleans	2.90	3.30	3.20
Minneapolis	2.50	2.50	2.39
Denver	2.84	2.84	2.85
Seattle	2.90	2.90	2.90
Dallas	2.25	2.25	2.25
Atlanta	**3.00**	2.85	2.50
Cincinnati	2.54	2.54	2.46
Los Angeles	*3.16*	3.16	3.30
Baltimore	2.65	2.65	2.50
Birmingham	2.70	2.70	2.10
Kansas City	**2.90**	2.55	2.85
Montreal	2.25	2.25	2.78
Philadelphia	2.75	....	2.41
St. Paul	2.50	2.50	2.39

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors

Buffington, Ind	$1.95	Hudson, N. Y.	$2.20
Universal, Pa	2.00	Leeds, Ala	2.20
Steelton, Minn	2.06	Hannibal, Mo	2.10
Fordwick, Va	2.10	Lehigh Valley District	2.10
Mitchell, Ind	2.10	Wyandotte, Mich	2.30
Iola, Kan	2.10	Alpena, Mich	2.10
Mason City, Ia	2.10	Richard City, Tenn	2.20
La Salle, Ill	2.10	Kingsport, Tenn	2.20

TRIANGLE MESH—Price per 100 sq.ft in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0.95	$1.02	$1.24	$1.04	$1.12	$1 16
047	28	1.20	1.30	1.58	1.32	1.38	1 47
068	35	1.47	1.59	1.94	1.62	1 67	1 81
093	45	1 89	2.04	2.50	2.08	2.00	2 32
126	57	2.34	2.53	3.09	2.59	2.55	2 88
153	68	2.79	3.02	3.60	3.08	3.15	.....
180	78	3.20	3.47	5.22	3.54	3.47	.....
245	103	4.22	4.57	4.60	4.66	4.58	.....
287	119	4.88	5.28	6 44	5.39	5.26	6.00
336	138	5.66	6.13	7.39	6.25	6.11	.....
395	160	6.56	7.10	8 67	7.25	7.12	.....
		PAVING					
036P	17	$0.72	$0.78	$0.95	$0.79	$0.76	.....
053P	24	1.02	1.10	1.35	1.12	1.07	.....
072P	31	1.29	1.40	1.71	1.42	1.39	.....
097P	40	1.66	1 80	2 20	1.83	1.90	.....
049R	24	.....	1.10	.....	1.12	1 07	.....
067R	31	.....	1.40	.....	1.42	1.39	.....
089R	40	.....	1.80	.....	1.83	1 90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	$21 25	$20 72	*$20 00*	$25.50
26 "	2.5	22.00	22 50	22 39	*19.11*	27 58
25 "	3.0	22 00	25 25	24 93	.....	30 71
24 "	3.4	24 00	27 25	27 10	*24 09*	33 16
22 "	4.33	27.00	31 75	32 27	.....	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger..	$2 40	$2 55	$3 54	$3 20	$3.35	$3 80	$3 65
⅜	2 45	2.75	3 59	3.25	3 50	3 85	3.75
½	2 50	2.85	3 64	3.30	3 55	3 90	3.85
⅝	2 65	2 90	3 69	3.45	3.75	4.05	4.05
¾	2 90	2 95	4.04	3 70	4.35	4.30	4.65

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$2 30	$3.05	$3.50	⅜	$2 55	$3.30	$3.75
½ in.....	2.35	3.10	3.55	¼	2 80	3.50	4.00
⅜	2.40	3.15	3.60	.....	.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Sept. 6	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.).....	*$23.65*	$24.60@25.70	$21.30@23.50	$46.50	$54.00
New York (at dock)...	*20.00*	21@22	18@20	.....	.....
Chicago	11.00	11.00	11.00	34.00	42.00
St. Louis, salmon.....	16@18	16@18	14 00	38@40	40@42.50
Denver, salmon.....	12.00	12.00	12.00	.....	.....
Dallas.....	13.10	13.10	10.90	33.00	.....
San Francisco.....	15.00	15.00	15.00	.....	.....
Los Angeles (del.).....	*15.50*	16.00	15.00	(not used)	
Boston (del.).....	23.00	22.00	.....	48.25	56.00
Minneapolis (del.).....	17@19	17@19	18@19	.....	.....
Kansas City.....	14.50	14.50	16.00	.....	.....
Seattle.....	13.00	13.00	14.00	50.00	.....
Cincinnati.....	17@20	17@20	15.00	45.00	50.00
Montreal.....	16.50	16.50	16 00	100.00‡	68.00
Detroit (del.).....	*18.50*	19.00	16 50	38.50	41.50
Baltimore (del.).....	21.00	21.00	20.00	40.00	45.00
Atlanta.....	12 00	12 00	11.00	40.00	45.00
New Orleans.....	18.75	18.75	13.00	.....	.....
Birmingham.....	13.50@16	13.50@16	.512.00	.....	.....
Philadelphia.....	22.00	.....	17.50@18.50	38.00	46.00
Pittsburgh (del.).....	16.00	16.00	16.00	.....	.....
Cleveland	16.00	16.00	16.00	.....	.....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Sept. 6 on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12...	*$0.1263*	$0.1112	$0.0724	$0.135	*$0.089*	$0.108	.....
6x12x12...	*.1895*	.1667	.0996	.....	*.122*	.156	.....
8x12x12...	*.2369*	.2084	.1358	.23	*.162*	.244	*$0.2255*
10x12x12...	.....	.....	.1695	.....	*.186*	.....	*.2779*
12x12x12...	.....	.....	.1937	.....	*.232*	.....	*.3613*

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston.....	*$0 13*	$0.24	.....
Minneapolis (f.o.b. cars).....	.0736	.12125	$0.214
Minneapolis (delivered).....	.0816	.13375	.234
Cincinnati.....	.0815	.153	....
Kansas City.....	.085	*.138*	.....
Denver.....	.065	.123	.188
Seattle (delivered).....	.11	.25	.36
Los Angeles factory.....	.1042	.1880	....
New Orleans.....	.12	.23	.....
Detroit (delivered).....	.1145	.2147	.27
Montreal.....	.115	.225	.30
Baltimore.....	.125	.27	.....
Atlanta.....	.102	.175	.....
Dallas.....	.115	....	.....
Birmingham.....	.11	.18	.....
Pittsburgh (delivered).....	.068	.128	.179
Cleveland	.09	.172	.....

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in	$2.50	$2 75	$3 64	$4 20	$3 45	$3.40	$3.60
Channels, 3 to 15 in....	2 50	2.75	3.64	4 20	3 45	3.40	3.60
Angles, 3 to 16 in., ¼ in. thick.....	2 50	2 75	3 64	4 20	3.45	3.40	3.60
Tees, 3 in. and larger...	2 50	2.75	3 64	4 20	3.50	3.40	3.60
Plates, ¼ in. thick and heavier.....	2.50	2.75	3.64	4.30	3.45	3.40	3.60

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York—Sept. 6	New York—One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$3.00@3.25	$4.40	$3.85	$3.75	$4.15	$5.00	$4.90
CONE HEAD BOILER							
½ in. and larger	$3.10@3.35	$4.50	$3 95	$3.85	$4.25	$5.10	$5.00
⅜ and 11/16.....	3.25@3.50	4.66	4.11	4.00	4.40	5.25	5.15
½ and ⅝.....	3.50@3.75	4.90	4.35	4.25	4.60	5.50	5.40

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.....	$3.00	$3.45	$4.25	$4.25	$3.34	$4.95
Cut.....		5 50	5.80	5.75	3.74	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco—Galv.	San Francisco—Black	Seattle Black
½.....	$9.85	$7.65	$8.0
⅝.....	7.80	6.30	7.2
¾.....	7.75	6.15	7.

Pittsburgh base in lots of 200 kegs or more, $3.50

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls 108 sq.ft. costs $2.50 per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in l) f.o.b. Philadelphia, l.c.l., *$5.55* per square.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton.....	$67.50
Tar pitch (in 400-lb. bbl.), per 100 lb	1.62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*.....	38.75
Asphalt felt (light), per ton, f.o.b. plant*.....	75.00
Asphalt felt (heavy), per ton, f.o.b. plant*.....	75.00

* Delivered in Metropolitan Dist., $3.00 additional.

WINDOW GLASS—Double strength, box list, united inches, 34, "AA" grade, at discount of 84 per cent from standard lists, f.o.b. New York; "A" grade less 86 per cent and "B" grade, 87 per cent.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10.....	$3.00	$4.45	$4.15	$5.25	$4.59
No. 12.....	3.10	4.50	4.20	5.30	4.64
No. 14.....	3.20	4.55	4.25	5.35	4.69
No. 16.....	3.40	4.65	4.35	5.40	4.79
Black					
*Nos. 18 and 20.....	3.70	5.00	5.05	*5.60*	*4.90*
*Nos. 22 and 24.....	3.75	5.05	5.05	*5.65*	*4.85*
*No. 26.....	3.80	5.10	5.10	*5.70*	*4.90*
*No. 28.....	3.85	5.20	5.20	*5.80*	*5.00*
Galvanized					
No. 10.....	4.00	5.35	5.35	5.50	*5.00*
No. 12.....	4.10	5.45	5.45	5 60	*5.10*
No. 14.....	4.10	5.45	5.45	5.75	*5.10*
No. 17 to 21.....	4.40	5.75	5.74	5.90	*5.40*
Nos. 22 and 24.....	4.55	5.90	5.90	6.05	*5.55*
*Nos. 25 and 26.....	4.70	6.05	6.05	6.20	*5.70*
*No. 28.....	5.00	6.35	6.25	6.50	*6.00*

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Sept. 6	New York: One Year Ago	Chicago: Sept. 6	Chicago: One Year Ago
Raw in barrels (5 bbl. lots).....	*$0.96*	$0.91	*$1.14*	$0.99

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry		In Oil	
	Sept. 6	1 Yr. Ago	Sept. 6	1 Yr. Ago
Red	14.00	12.50	15.50	14.00
White	14.00	12.50	14.00	12.50

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$37.00	$38.00	$39.00	$42.00
3x6 and 8	37.00	38.00	39.00	42.00
4x4-6 and 8	37.00	38.00	39.00	42.00
3x10 and 12	37.00	38.00	39.00	42.00
3x14	39.00	39.00	41.00	43.00
4x10 and 12	37.00	38.00	39.00	42.00
4x14	39.00	39.00	41.00	43.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$39.00	$41.00	$43.00
6x14	44.00	46.00	48.00
8x10	39.00	41.00	43.00
8x14	44.00	46.00	48.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	$50.00	$51.00	$45.50	$47.50
3x10 to 10x10	54.00	55.00	51.50	53.50
3x12 to 12x12	58.00	59.00	58.50	60.50
3x14 to 14x14	65.00	68.00	64.50	66.50
3x16 to 16x16	70.00	71.00	72.50	74.50
3x18 to 18x18	84.00	85.00	89.50	84.50
4x20 to 20x20	94.00	95.00	.....	.....

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$65.00	.....	$60.00	$60.00	$82.00	.....
Seattle	.....	$28.00	.....	.....	.....	$28.00
New Orleans	28.00	.....	.....	.....	31.00	.....
Baltimore	33.50	53.00	53.00	60.00	50.00	53.00
Cincinnati	40.00	75.00	75.00	90.00	44.00	80.00
Montreal	50.00	.....	.....	.....	70.00	90.00
Los Angeles	.....	50.00	.....	.....	.....	51.00
Denver	.....	43.25	.....	.....	.....	44.25
Minneapolis	42.00	42.50	41.50	.....	44.00	43.75
Atlanta	36.00	.....	.....	.....	40.00	.....
Dallas	47.50	.....	.....	.....	52.25	.....
Kansas City	43.25	.....	.....	.....	56.25	.....
Birmingham	30@35	.....	.....	.....	40@45	.....
Philadelphia	63.00	62.00	62.00	77.00	75.00	73.00
Detroit	45.75	50.25	.....	.....	58.75	50.25
St. Louis	44.00	.....	.....	.....	56.00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$50.00	$85.00	$50.00	$58.00	.....
Seattle	.....	24.00	.....	.....	$26.00
New Orleans	72.00	.....	.....	31.00	.....
Baltimore	60.00	44.00	44.00	34.00	50.00
Cincinnati	76.00	81.00	76.00	35.00	90.00
Montreal	.....	50.00	37.00	45.00	45.00
Los Angeles	.....	45.00	.....	.....	.....
Denver	.....	34.25	34.25	.....	34.25
Minneapolis	42.00	40.75	39.50	38.25	37.25
Atlanta	20.00	.....	.....	30.00	.....
Dallas	47.50	.....	.....	50.83	.....
Kansas City	47.50	.....	.....	36.00	.....
Birmingham	26@30	.....	.....	38@40	.....
Philadelphia	33.00	60.00	46.00	52.00	68.00
Detroit	42.50	37.00	.....	42.50	40.50
St. Louis	40.00	.....	.....	29.00	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M.ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. [illegible] Pittsburgh, with a comparison of a month and a year ago:

Sept. 6	One Month Ago	One Year Ago
$2.65	$2.65	$2.30

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	20%
Patent flattened strand, special steel wire rope	20%
Patent flattened strand, iron rope	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington Discount: 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ½-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft.; ⅝-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ½-in. and larger, in 1200-ft. coils:

Boston	0.17½	New Orleans	0.18½
New York	.18½	Los Angeles	.18
Chicago	.18	Seattle	.18
Minneapolis	.20½	St. Louis	.19½
San Francisco	.18	Montreal	.23
Atlanta	.20	Detroit	.20
Denver	.22	Baltimore	.18
Cincinnati	.21	Kansas City	.21½
Dallas	.21	Birmingham	.20½
Philadelphia	.19		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.24	.26
Kansas City	.2225	.2475
Seattle	.165	.19
Chicago	.22	.25
Minneapolis	.1917	.2123
St. Louis	.2275	.2475
Denver	.2025	.2275
Dallas	.225	.305
Los Angeles	.17	.20
Atlanta	.23	.2575
Baltimore	.22	.23
Cincinnati	.225	.25
Montreal	.195	.235
Birmingham, *delivered*	.16	.17
New Orleans	.195	.22
San Francisco	.1625	1925
Philadelphia	.215	.240

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f. o. b. New York:

Sulphate of aluminum, in bags, per 100 lb.	$1.40@1.50
Sulphate of copper, in bbl., per 100 lb.	5.10@5.25
Soda ash, 58%, in bags, per 100 lb.	1.45@1.51
Chlorine, liquid, cylinders, 100 lb., per lb.	.09
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	2.00@2.10

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.34†
Cincinnati	.29	Philadelphia	.32
Cleveland	.215	St. Louis	.43
Denver	1.27*	St. Paul	.60

† Minimum carload, 40,000 lb.
* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.

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